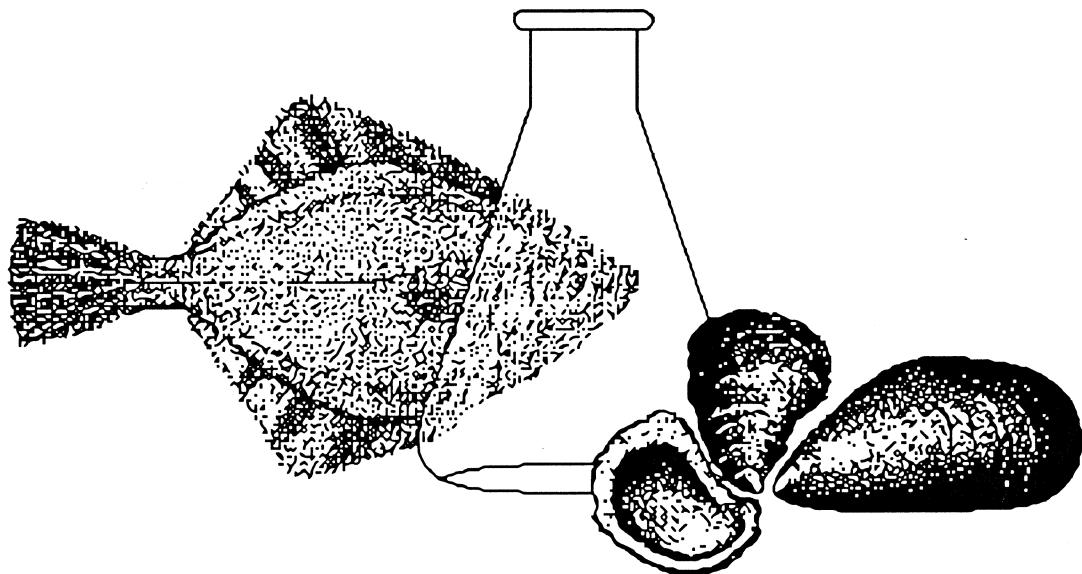


**National Status and Trends Program
for Marine Environmental Quality**

**Quality Assurance Project
Trace Organic Intercomparison Exercise Results
1986 - 1990**



Rockville, Maryland
April, 1993

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Coastal Monitoring and Bioeffects Assessment Division
Office of Ocean Resources Conservation and Assessment
National Ocean Service



NOAA Technical Memorandum NOS ORCA 69

Quality Assurance Project
Trace Organic Intercomparison Exercise Results
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Adriana Y. Cantillo and Reenie M. Parris



Rockville, Maryland
April, 1993

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Department of Commerce

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LIST OF ACRONYMS

AHs	Aromatic hydrocarbons
DDTs	1,1'-(2,2,2-Trichloroethylidene)bis[4-chlorobenzene] and metabolites
ICES	International Council for the Exploration of the Seas
IOC	Intergovernmental Oceanographic Commission
NAF	National Analytical Facility, NOAA/NMFS/Northwest Fisheries Science Center
NIST	National Institute of Standards and Technology (formerly National Bureau of Standards)
NMFS	National Marine Fisheries Service, NOAA
NEFSC	NOAA/NMFS/Northeast Fisheries Science Center
NWFSC	NOAA/NMFS/Northwest Fisheries Science Center
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council of Canada
NS&T	NOAA National Status and Trends Program
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
QA	Quality assurance
SAIC	Science Applications International Corporation
SEFSC	NOAA/NMFS/Southeast Fisheries Science Center, Charleston, SC
SRM	Standard Reference Material
TAMU	Texas A&M University

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ABSTRACT

The NOAA National Status and Trends (NS&T) Program determines the current status and any changes over time of the environmental health of the estuarine and coastal waters. Concentrations of organic and inorganic contaminants are determined in mollusks, bottom-dwelling fish and sediments collected along the coast of the U.S. The quality of the analytical data generated by the NS&T Program is overseen by its QA Project component, that is designed to document sampling protocols, analytical procedures, and laboratory performance, and to reduce intralaboratory and interlaboratory variation. NS&T does not specify analytical methodology. Laboratories can use any analytical procedure as long as the results of the intercomparison exercises are within certain specified limits. All NS&T laboratories are required to participate in yearly intercomparison exercises. The results of the intercomparison exercises are described and discussed.

1. INTRODUCTION

Long-term monitoring studies, whether local, regional, or global, require that data of known quality be generated by all participants. These data must be comparable to one another, and be traceable to a common reference point. Since 1984, the National Oceanic and Atmospheric Administration (NOAA) has conducted the National Status and Trends (NS&T) Program, a long-term monitoring study of the coastal waters of the United States. Since its inception, quality assurance has played a major role in the design of the program, the evaluation of potential analytical contractor laboratories, and the maintenance of data quality.

2. NATIONAL STATUS AND TRENDS PROGRAM

NOAA's National Status and Trends (NS&T) Program assesses the current status and changes over time of the environmental health of the estuarine and coastal waters of the United States, including Alaska and Hawaii. The NS&T Program consists of seven major components: the National Benthic Surveillance Project, the Mussel Watch Project, Bioeffects and Research Surveys, Historical Trends Analyses, the Specimen Bank, and the Quality Assurance (QA) Program. In addition, a database of NS&T data is being maintained.

Concentrations of organic and inorganic contaminants in sediments and bottom-dwelling fish taken in the same area are determined as part of the National Benthic Surveillance Project at sites located around the nation. The analytes include 24 polycyclic aromatic hydrocarbons, 18

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polychlorinated biphenyl congeners, DDT and its metabolites, 9 other chlorinated pesticides, organotins, 4 major elements and 12 trace elements. The organic analytes are listed in Table 1. Toxaphene, DNA adducts, and aryl hydrocarbon hydroxylase are measured at certain sites. The frequency of external disease conditions and internal lesions (liver tumors) in the bottomfish are also being documented. Currently, there are about 80 National Benthic Surveillance sites in estuaries and coastal waters, including both urban and rural areas. Samples are generally collected biannually at these sites. Sample collection and analyses for the National Benthic Surveillance Project are currently done by the NOAA National Marine Fisheries Service (NMFS) Northwest Fisheries Science Center National Analytical Facility (NAF), Seattle, WA, and the NMFS Beaufort Laboratory, Beaufort, NC.

The same chemicals are determined in sediments and mussels or oysters as part of the Mussel Watch Project. The bivalves are collected on a yearly basis from approximately 240 sites in the United States, while sediments are collected at the same sites on a less-than-yearly basis. Sample collection and analysis for the Mussel Watch Projects are currently done by the Texas A&M University (TAMU) Geochemical and Environmental Research Group, College Station, TX, and the Battelle Ocean Sciences (BATTELLE) laboratories at Duxbury, MA, and Sequim, WA.

The Biological Effects Studies consist of a series of intensive 2- to 3-year surveys primarily conducted in areas with potentially substantial environmental degradation and are focused in areas with definite contamination gradients. The studies include investigations of reproductive impairment and sediment toxicity.

An integral part of the NS&T Program is the QA component, which has been in operation since 1985 and is designed to document the quality of the data generated. This document describes the trace organic portion of the NS&T QA Project and the results of the trace organic intercomparison exercises organized as part of the QA effort.

Historical Trends Assessments combine NS&T data with historical data to provide assessments about environmental concerns. These assessments primarily involve a closer examination of environmental conditions in areas indicated as having high levels of specific contaminants. Comparison of data generated over time should be done with caution as differences in analytical methodology, especially those for trace organic determinations, may render such comparisons invalid. Samples from dated sediment cores collected at various sites nationwide will be analyzed for the NS&T parameters and others to determine the deposition over time of such contaminants.

There may be chemical contaminants in the environment that are not now recognized as being of concern. It is also possible that analytical procedures may change significantly in the future from those being used currently. Because of these possibilities, the NS&T Program is building and maintaining a specimen bank in conjunction with the National Institute of Standards and Technology (NIST), Gaithersburg, MD. Samples are collected each year at approximately 10% of the NS&T sites, shipped to NIST, and stored in liquid nitrogen freezers at -150°C.

Table 1. Organic chemicals determined as part of the NOAA National Status and Trends Program.

Analytes	CAS Numbers [◊]	Analytes	CAS Numbers [◊]
Polycyclic aromatic hydrocarbons			DDT and metabolites
Biphenyl	92-52-4	2,4'-DDD	53-19-0
Naphthalene	91-20-3	4,4'-DDD	72-54-8
1-Methylnaphthalene	90-12-0	2,4'-DDE	3424-82-6
2-Methylnaphthalene	91-57-6	4,4'-DDE	72-55-9
2,6-Dimethylnaphthalene	581-42-0	2,4'-DDT	58633-27-5
Acenaphthene	83-32-9	4,4'-DDT	50-29-3
Acenaphthylene	208-96-8		
1,6,7-Trimethylnaphthalene	2245-38-7	Chlorinated pesticides other than DDT	
Fluorene	86-73-7	Aldrin	309-00-2
Phenanthrene	85-01-8	cis-Chlordane	5103-71-9
1-Methylphenanthrene	832-69-9	Dieldrin	60-57-1
Anthracene	120-12-7	Heptachlor	76-44-8
Fluoranthene	206-44-0	Heptachlor epoxide	1024-57-4
Pyrene	129-00-0	Hexachlorobenzene	118-74-1
Benz[a]anthracene	56-55-3	gamma-HCH	58-89-9
Chrysene	218-01-9	Mirex	2385-85-5
Benzo[a]pyrene	50-32-8	trans-Nonachlor	39765-80-5
Benzo[e]pyrene	192-97-2		
Perylene	198-55-0		
Dibenz[a,h]anthracene	53-70-3		
Benzo[b]fluoranthene	205-99-2		
Benzo[k]fluoranthene	207-08-9		
Indeno[1,2,3-cd]pyrene	193-39-5		
Benzo[gh]perylene	191-24-2		
Polychlorinated biphenyl congeners (numbering system of Ballschmiter and Zell, 1980)*			
Individual congeners	IUPAC Numbers	CAS registry numbers [◊]	
2,4'-Dichlorobiphenyl	8	34883-43-7	
2,2',5-Trichlorobiphenyl	18	37680-65-2	
2,4,4'-Trichlorobiphenyl	28	7012-37-5	
2,2',3,5'-Tetrachlorobiphenyl	44	41464-39-5	
2,2',5,5'-Tetrachlorobiphenyl	52	35693-99-3	
2,3',4,4'-Tetrachlorobiphenyl	66	32598-10-0	
3,3',4,4'-Tetrachlorobiphenyl	77(110*) ^Δ	32598-13-3 (38380-03-9)	
2,2',4,5,5'-Pentachlorobiphenyl	101	37680-73-2	
2,3,3',4,4'-Pentachlorobiphenyl	105	32598-14-4	

* There are three discrepancies between the PCB numbers published by Ballschmiter and Zell (BZ) (1980) and those published by Schulte and Malisch (SM) (1983). These are: BZ PCB 199 is the same as SM PCB 201 which is 2,2',3,3',4,5,5',6-octachlorobiphenyl; BZ PCB 200 which is the same as SM PCB 199 which is 2,2',3,3',4,5,6,6'-octachlorobiphenyl; and BZ PCB 201 which is PCB 200 which is 2,2',3,3',4,5',6,6'-octachlorobiphenyl. These discrepancies do not affect the NS&T list of analytes and are listed here for information only.

^Δ Not part of NS&T QA Program.

Table 1. Organic chemicals determined as part of the NOAA National Status and Trends Program. (cont.)

Individual congeners	IUPAC Numbers	CAS registry numbers [◊]
2,3',4,4',5-Pentachlorobiphenyl	118	31508-00-6
3,3',4,4',5-Pentachlorobiphenyl	126 ^Δ	57465-28-8
2,2',3,3',4,4'-Hexachlorobiphenyl	128	38380-07-3
2,2',3,4,4',5'-Hexachlorobiphenyl	138	35065-28-2
2,2',4,4',5,5'-Hexachlorobiphenyl	153	35065-27-1
2,2',3,3',4,4',5-Heptachlorobiphenyl	170	35065-30-6
2,2',3,4,4',5,5'-Heptachlorobiphenyl	180	36065-29-3
2,2',3,4',5,5',6-Heptachlorobiphenyl	187	52663-68-0
2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	52663-78-2
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	206	40186-72-9
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	2051-24-3

[◊] Chemical Abstracts Service registry numbers

The NS&T data are stored in computer databases and are made available in several formats. Over 300 publications, reports and presentations, and technical memoranda have been published based on NS&T data. The NS&T data may be requested from the NS&T Program office.

3. OBJECTIVES OF THE QA PROJECT

The quality of the analytical data generated by the NS&T Program is overseen by the QA Project component, which is designed to document sampling protocols and analytical procedures, and to reduce intralaboratory and interlaboratory variation. The QA Project documentation will also allow eventual comparison of data from various other monitoring programs with similar QA activities and thus will extend the temporal and spatial scale of such programs. To document laboratory expertise, the QA Project requires all NS&T laboratories to participate in a continuing series of intercomparison exercises utilizing a variety of materials. The organic analytical intercomparison exercises are coordinated by NIST, and the inorganic exercises by National Research Council (NRC) of Canada. Sampling and analytical protocols used in the NS&T Program since its inception are documented in Lauenstein and Cantillo (1993). This document will be periodically updated as changes in sampling and analytical protocols occur.

4. APPROACH

4.1. Methodology

NS&T does not specify analytical methodology. Laboratories can use any analytical procedure as long as the results of the intercomparison exercises and reference materials are within certain specified limits of the consensus values. This allows the use of new or improved analytical methodology or instrumentation without compromising the quality of the data sets. It also encourages the contractor laboratories to use the most cost-effective methodology while generating data of documented quality.

All analytical methodology and sampling protocols used are fully documented for future reference (Lauenstein and Cantillo, 1993). This document will provide a detailed record of protocol changes with time as improvements take place.

4.1.1. Standard reference and control materials

The analysis of reference materials, such as the NIST Standard Reference Materials (SRMs), and of control materials generated for use by NS&T laboratories, as part of the sample stream is required. Data from the analysis of control materials and all matrix reference materials are reported to the NS&T Program office. These data are stored in the same format and at the same time as sample data to form an auxiliary to the main NS&T database.

4.1.2. Procedures and standards

In NS&T trace organic analytical procedures, internal standards and surrogates are added at the start of the procedure and carried through the extraction and cleanup and are used for quantification by instrumental analysis. Acceptable recovery rates are left to the professional judgement of the analyst. It is the analyst's responsibility to monitor recovery rates and to determine acceptability based on individual laboratory recovery criteria.

4.1.3. Instrument calibration

The results of calibration checks performed at the beginning and end of each typical sample string must be within $\pm 10\%$ of the accuracy-based value for standards in order to consider the instrument used to be within calibration. The results of the spike blank analysis must be within $\pm 20\%$ of the correct value in order to consider the method to be in a state of control.

4.1.4. Sample quantification

All samples must be quantified within the calibration range. Quantification based on extrapolation is not acceptable.

4.1.5. Method detection limits

Method Detection Limits (MDLs) are determined and reported annually for each analyte of interest in each matrix of interest (e.g., mussel, oyster, sediment). Prior to 1989, the limit of quantitation (LOQ) as defined by Keith *et al.* (1983) was used. Since 1989, the method used for calculating MDLs is that prescribed by EPA and described in the 7/1/88 edition of the Federal Register (Definition and Procedure for the Determination of the Methods Detection Limit - Revision 1.11). If the EPA method is not used or is modified, the procedure used for DL determination is described in detail by the laboratory in its annual report. Separate MDLs are determined for mussels and oysters. No extra level of effort is made to quantitate or verify data for the NS&T Program below the MDL.

4.1.6. Precision

Acceptable limits of precision, expressed as percent relative standard deviation, %RSD, for organic control materials are $\pm 30\%$ on average for all analytes, and $\pm 35\%$ for individual analytes. These limits apply to those materials where the concentrations of the compounds of interest are at least 10 times greater than the MDLs for those compounds. The application of these guidelines in determining the acceptability of the results of the analysis of a sample is a matter of professional judgement on the part of the analyst, especially in cases where the analyte level(s) is near the limit of detection.

Horwitz *et al.* (1980) discussed the inverse relationship between sensitivity and precision and found that, in general, the precision, as a function of concentration, appears to be independent of the nature of the analyte or the analytical technique. The interlaboratory coefficient of variation at the 10 ppb analyte level is expected to be approximately 30% (Figure 1).

4.1.7. Accuracy

The acceptable limit of accuracy is $\pm 30\%$ of the consensus or, when available, the certified range of analyte concentration that is at least 10 times the limit of detection of the analyte. The certified values and uncertainties in the applicable NIST Certificates of Analysis for SRMs describe, statistically, the range in which there is a 95% probability that the true value is found. The $\pm 30\%$ range should therefore be calculated as 30% above and below the uncertainty ranges listed in the NIST Certificates of Analysis. For a certified value and uncertainty, $x \pm y$, the $\pm 30\%$ range is

$$(x + y) + [0.3(x + y)]$$

to

$$(x - y) - [0.3(x - y)].$$

4.2. Data acceptability criteria and archival

A minimum of 8% of the typical organic sample string should consist of blanks, reference or control materials, duplicates, and spike matrix samples. The use of control materials does not entirely replace the use of duplicates and spiked matrix samples. If available, use of an SRM is preferable since the analyte is incorporated in the sample matrix and problems with extraction and/or recovery would result in significant deviations from the certified values. This percentage may be reduced to 5% if blanks are not considered. The results of the routine analysis of reference and control materials, and of the intercomparison exercises, are stored electronically.

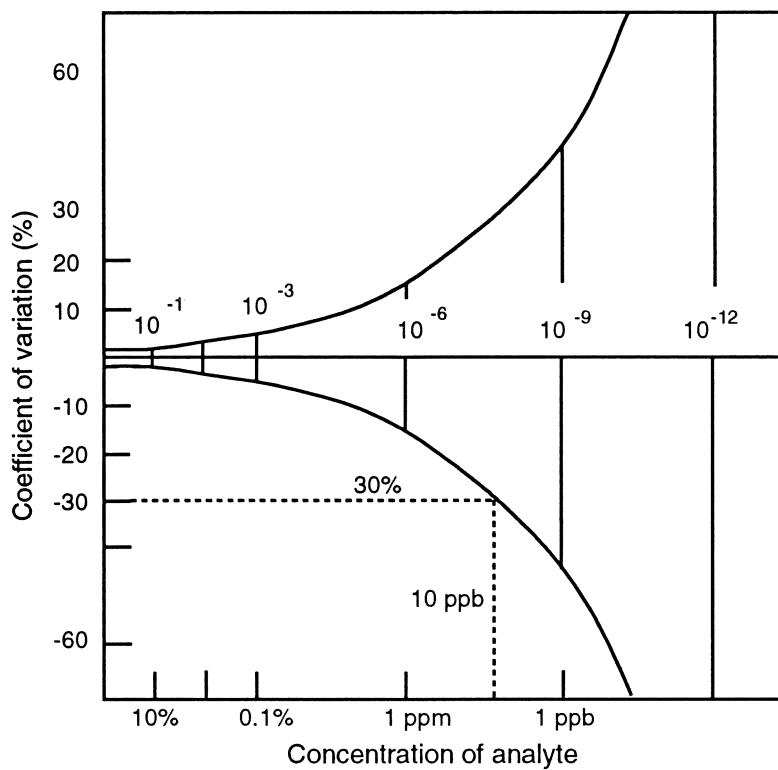


Figure 1. Interlaboratory coefficient of variation as a function of concentration [Adapted from Horwitz *et al.* (1980)].

4.3. Intercomparison exercises

All the NS&T laboratories are required to participate in the yearly intercomparison exercises. The materials used since the beginning of the exercises in 1986 are listed in Table 2. Non-NS&T laboratories participating in the exercises for the first time can request, if desired, a set of simple analyte solutions. Once these solutions are successfully analyzed, or if the laboratory did not request them, the exercise materials are sent to each laboratory. The exercise materials are usually sent early in the spring or summer, with complete handling instructions and diskette with the data reporting format. Calibration solutions are also provided to preclude errors caused by variations in standards. The type and matrix of the samples change yearly. Sample types have included simple gravimetrically-prepared analyte solutions, sediments, extracted tissues, and cryogenically homogenized tissues. If problems are encountered during any of the phases of the intercomparison exercises, the laboratories can contact NIST for assistance.

The results of the intercomparison exercises are not intended to reflect the absolute capability of a laboratory. Given more time and money, it is possible to employ methods with lower detection limits and possibly increased precision and accuracy. The 1986 exercises used spiked samples of sediment and tissue, and the 1987 exercise samples were real environmental samples. Beginning in 1988, the intercomparison exercises were designed to improve the methodology used by the NS&T laboratories by isolating sources of variability such as sample preparation and extraction. In that year simple solutions of the analytes of interest were used for interlaboratory comparison exercises. The complexity of the materials used increased as

Table 2. Materials used for the NS&T trace organic intercomparison exercises.

Y E A R	M A T E R I A L S	
1986 *	DUWAMISH III Ti86 Calibration solutions	Sediment from the Duwamish Estuary, Seattle, WA Mussel tissue from Puget Sound Standard II in Hexane
1987	Sed87 Ti87 Control materials Calibration solutions	Sediment from Baltimore Harbor Mussel tissue from Narragansett Bay (Tissue #1) Sediment from Baltimore Harbor Mussel tissue from Narragansett (Tissue #1) MacLeod calibration solutions used for sample analysis, and NIST SRMs 1491, 1492, and 1493
1988	VAR-PAH VAR-PCB VAR-PES Control materials Calibration solutions	PAHs in hexane and toluene (QA88S1AH) PCBs in 2,2,4-trimethylpentane (QA88S1CB) Pesticides in hexane (QA88S1PE) Sediment from Baltimore Harbor (Sed87) Mussel tissue from Narragansett (Tissue #1) Mussel tissue from Boston Harbor (Tissue #2) NIST SRMs 1491, 1492, and 1493
1989	VAR2-PAH VAR2-PCB VAR2-PES QA89T1 ICES PCBs Control materials Calibration solutions	PAHs in hexane and toluene (QA89S1AH) PCBs in 2,2,4-trimethylpentane (QA89S1CB) Pesticides in hexane (QA89S1PE) Oyster tissue First step - Chlorobiphenyl Congeners in Solvent Sediment from Baltimore Harbor (Sed87) Mussel tissue from Boston Harbor (Tissue #2) NIST SRMs 1491, 1492, 1493, 2260, 2261 and 2262
1990	VAR3-MIX QA90E1 ICES PCBs Control materials Calibration solutions	PAH, PCB and pesticides mixture in hexane (QA90S1MX) Enriched bivalve tissue extract Second step Sediment from Baltimore Harbor (Sed87) Mussel tissue from Boston Harbor (Tissue #2) Tissue control material III (QC90TC) NIST SRMs 1491, 1492, 2260, 2261, and 2262

* Samples used in 1986 were prepared and spiked by NAF for an exercise organized through NAF. Since then, all sample preparation, distribution and exercise organization has been through NIST.

spiked tissue extracts and then unspiked tissue extracts were used for the exercise. Recent exercises using natural materials may be employed to assess method performance.

4.4. Quality assurance workshops

The results of the intercomparison exercises are discussed among NIST, NRC, and the participating laboratories during the yearly QA Workshop held in late fall or winter. During such meetings, a consensus is reached among NIST, NRC, NOAA, and the laboratories as to the type of materials that will be used for the following year's intercomparison exercise.

4.5. Development of standard reference and control materials

In response to the needs of the NS&T Program, NOAA has funded the production of eight NIST SRMs and seven internal standard solutions (Table 3). The SRMs are two natural materials and calibration solutions at two concentration levels of the three chemical classes of analytes. The latter are used to facilitate the preparation of multipoint calibration curves. Descriptions of these SRMs are in Appendix I. These SRMs and control materials, both sediment and bivalve tissue which were also prepared for the NS&T cooperating laboratories, have been and continue to be used by NS&T contract laboratories. The SRMs are available for purchase through NIST. The internal standard solutions were prepared by NIST at the request of the NS&T contract laboratories and are provided free of charge to the NS&T laboratories.

4.6. Participation by non-NS&T laboratories

Participation in the trace organic intercomparison exercises by non-NS&T laboratories on a voluntary basis has increased with time. NS&T encourages such participation by the marine environmental community and will continue to add laboratories to the exercises as funds permit.

5. ANALYTES

5.1. PAHs

The polycyclic aromatic hydrocarbons (PAHs) are a class of compounds of which benzo[a]pyrene is one of the most hazardous (Sittig, 1985). PAHs are found naturally. They may be formed by combustion processes and can be released in oil spills. The less efficient the combustion process, the higher the emission of PAHs. Some PAHs are known or suspected carcinogens. In fish, PAHs are metabolized and the levels of these compounds in fish tissue are very low. Structures of selected PAHs are shown in Figure 2. The sum of the concentrations of the low and high molecular weight PAHs will be used in graphic presentations for clarity. The PAHs in these two molecular weight categories are listed in Table 4.

5.2. PCBs

Polychlorinated biphenyls (PCBs) are widely distributed in the environment, and have no known natural source. There are 209 congeners, having from one to ten chlorines (Figure 2). Twenty of these congeners have non-ortho chlorine substitutions and so can attain a planar structure which makes them similar in structure to the highly toxic polychlorinated dibenzo-*p*-dioxins and dibenzofurans (McKinney *et al.*, 1985; Sericano *et al.*, 1991). In the scientific literature, total PCB concentrations are often reported and these values are calculated based on the response factors of PCB congeners representative of each chlorination level. PCBs were available in the

Table 3. NIST SRMs and internal standard solutions funded by the NS&T Program.

SRM 1491	Aromatic Hydrocarbons in Hexane/Toluene
SRM 1492	Chlorinated Pesticides in Hexane
SRM 1493	Chlorinated Biphenyl Congeners in 2,2,4-Trimethylpentane
SRM 1941	Organics in Marine Sediment
SRM 1974	Organics in Mussel Tissue (<i>Mytilus edulis</i>)
SRM 2260	Aromatic Hydrocarbons in Toluene (Nominal Concentration 60 µg/mL)
SRM 2261	Chlorinated Pesticides in Hexane (Nominal Concentration 2 µg/mL)
SRM 2262	Chlorinated Biphenyl Congeners in 2,2,4-Trimethylpentane (Nominal Concentration 2 µg/mL)
AH	Naphthalene-d ₈ , acenaphthene-d ₁₀ , benzo[a]pyrene-d ₁₂ , perylene-d ₁₂
PES	1,2,3-Trichlorobenzene, 4,4'-dibromooctafluorobiphenyl
TCMX	2,4,5,6-Tetrachloro- <i>m</i> -xylene
HMB	Hexamethylbenzene
COP Spike	Coprostan-3β-ol
COP I-STD	5α-Androstan-3β-ol
COP GC Cal.	Hexamethylbenzene, coprostan-3β-ol, 5α-androstan-3β-ol

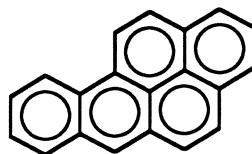
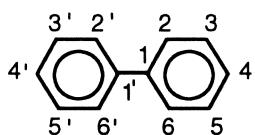
* SRMs 1491 and 2260; and 1492 and 2261 have the same suite of analytes at different concentrations. SRM 1493 contains 20 PCB congeners, and SRM 2262 contains the same 20 congeners at different concentrations as SRM 1493 plus an additional 8 congeners.

Table 4. Polycyclic aromatic hydrocarbon molecular weight categories used in the NS&T Program.

Low molecular weight PAHs (2- and 3-ring structures)	High molecular weight PAHs (4- and 5-rings)
1-Methylnaphthalene	Benzo[a]pyrene
1-Methylphenanthrene	Benzo[b]fluoranthene
1,6,7-Trimethylnaphthalene	Benzo[e]pyrene
2,6-Dimethylnaphthalene	Benzo[ghi]perylene
2-Methylnaphthalene	Benzo[k]fluoranthene
Acenaphthene	Benz[a]anthracene
Acenaphthylene	Chrysene
Anthracene	Dibenzo[a,h]anthracene
Biphenyl	Fluoranthene
Fluorene	Indeno[1,2,3- <i>cd</i>]pyrene
Naphthalene	Perylene
Phenanthrene	Pyrene

Figure 2. Selected organic compound structures and CAS registry numbers.

PCB parent structure

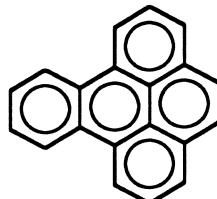


Benzo[*a*]pyrene
50-32-8

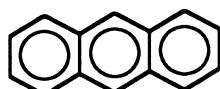
Polycyclic aromatic hydrocarbons



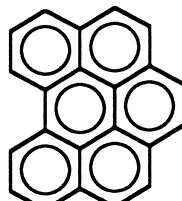
Naphthalene
91-20-3



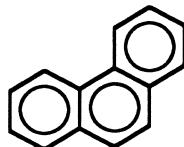
Benzo[*e*]pyrene
192-97-2



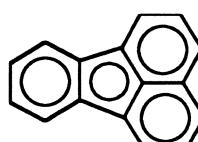
Anthracene
120-12-7



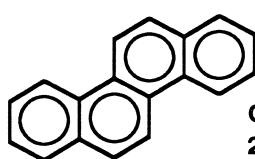
Benzo[*ghi*]perylene
191-24-2



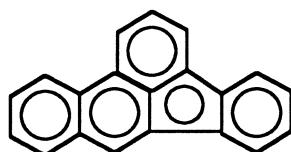
Phenanthrene
85-01-8



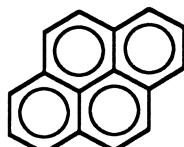
Fluoranthene
206-44-0



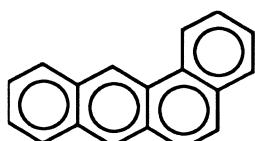
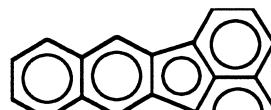
Chrysene
218-01-9



Benzo[*b*]fluoranthene
205-99-2



Pyrene
129-00-0

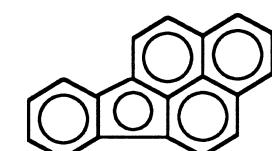


Benz[*a*]anthracene
56-55-3

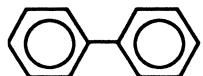
Benzo[*k*]fluoranthene
207-08-9



Dibenz[*a,h*]anthracene
53-70-3



Indeno[1,2,3-*cd*]pyrene
193-39-5



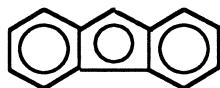
Biphenyl
92-52-4



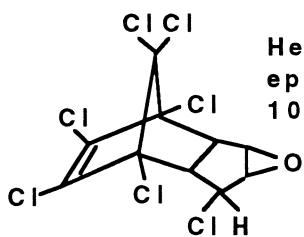
Acenaphthene
83-32-9



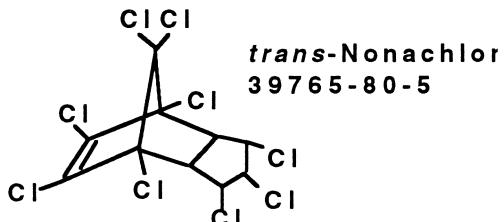
Acetanaphthylene
208-96-8



Fluorene
86-73-7

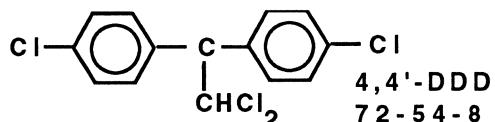


Heptachlor epoxide
1024-57-3

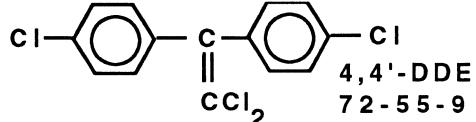


trans-Nonachlor
39765-80-5

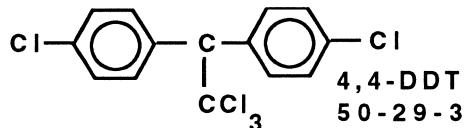
DDT and metabolites



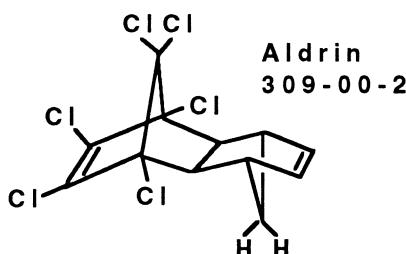
4,4'-DDD
72-54-8



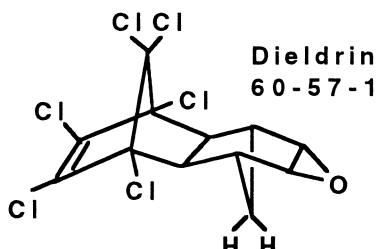
4,4'-DDE
72-55-9



4,4-DDT
50-29-3

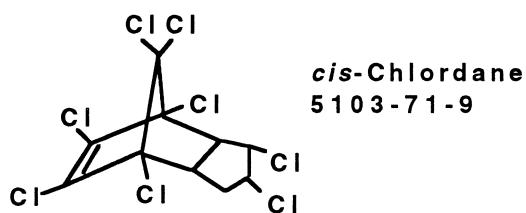


Aldrin
309-00-2

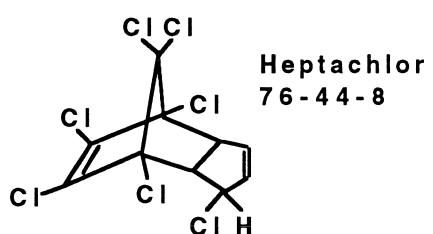


Dieldrin
60-57-1

Cyclopentadiene pesticides

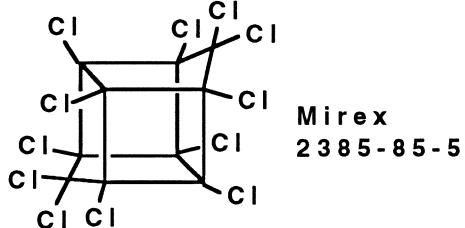


cis-Chlordane
5103-71-9

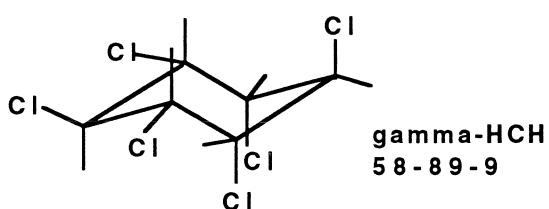


Heptachlor
76-44-8

Other pesticides



Mirex
2385-85-5



gamma-HCH
58-89-9

Table 5. Some PCB congeners that may coelute depending upon analytical conditions (Schantz *et al.*, 1993).

PCB 18 and PCB 15	PCB 110 and PCB 77
PCB 28 and PCB 31	PCB 138, PCB 163 and PCB 164
PCB 52 and PCB 49	PCB 153, PCB 132 and PCB 105
PCB 66 and PCB 95	PCB 170 and PCB 190
PCB 101 and PCB 90	PCB 187, PCB 182 and PCB 159

U.S. as a series of mixtures of congeners called Aroclors, with different average composition of congeners, and PCB concentrations have also been reported as Aroclors. For simplicity, the sum of the concentrations of the PCB congeners determined in each of the intercomparison exercises will be used in the graphic presentation of the results. Individual congener concentration data are listed in the Appendices.

According to Schultz *et al.* (1989), some PCBs of interest have potentially coeluting congeners on the capillary column typically used by NS&T laboratories for PCB analyses. Coelution of congeners is dependent upon instrumental conditions such as column type, length, internal diameter, film thickness, and oven temperature. Some potentially coeluting PCB congeners are listed in Table 5. Therefore, it should be noted that although the calibration standards contain the pure PCB congeners, the PCBs identified in field samples, field sample extracts, or SRMs may actually be combinations of the congeners listed above.

5.3. Pesticides

DDT (4,4'-DDT) or 1,1'-(2,2,2-trichloroethylidene)bis[4-chlorobenzene] has been widely used as an insecticide since 1929 (Klaassen *et al.*, 1986). Its use was banned in the U.S. in 1972. 4,4'-DDT is metabolized by the loss of a chlorine to yield the non-insecticidal 4,4'-DDE ((1,1'-(dichloroethylidene)bis[4-chlorobenzene]), and by the substitution of a chlorine by a hydrogen to yield 4,4'-DDD ((1,1'-(2,2-dichloroethylidene)bis[4-chlorobenzene])). DDT and some of its metabolites are toxicants, with long-term persistence in soil and water; are widely dispersed by erosion, runoff and volatilization; and accumulate in adipose tissue in wildlife and humans. As in the case of PCBs, no known natural source of these compounds exists. The sum of the concentrations of DDT and the metabolites will be used in graphic presentations for clarity.

The cyclopentadiene pesticides form a family of compounds with similar structures (Figure 2). Aldrin is metabolized into dieldrin by epoxidation (White-Stevens, 1971). Dieldrin is resistant to metabolism. Aldrin and dieldrin are extremely toxic. Heptachlor is also slowly epoxidized in animal tissue resulting in heptachlor epoxide. Technical chlordane is a mixture of compounds containing heptachlor, *cis*-chlordane, *trans*-chlordane, and others. Since these compounds have similar structures, the sum of the concentrations of the cyclopentadiene pesticides determined in each of the intercomparison exercises will be used in the graphic presentation of the results. The individual concentration data are listed in the Appendices.

The chemical name of Lindane or gamma-HCH is (1 α ,2 α ,3 β ,4 α ,5 α ,6 β isomer)-1,2,3,4,5,6-hexachlorocyclohexane (HCH). The gamma isomer is the most toxic isomer of hexachlorocyclohexane; 500 to 1000 times as active as the alpha isomer (White-Stevens, 1971). Technical grades of gamma-HCH used as insecticides contained a mixture of isomers. Currently, the gamma isomer is marketed. Of these, gamma and alpha are convulsant poisons in

humans, beta and delta are central nervous system depressants, and epsilon and eta appear to be inactive (Murphy, 1986).

Mirex has been used in the southeast U. S. to control fire ants (Murphy, 1986). It is accumulated and stored in adipose tissue and is persistent. It degrades into its 2-keto derivative, kepone (chlordecone), which is also toxic. Hexachlorobenzene is widely distributed in the environment due to its use in agriculture and wood products (Sittig, 1985). It is also used as a fluxing agent in aluminum smelting and is a byproduct of pentachlorophenol and vinyl chloride monomer production.

Hexachlorobenzene is highly persistent and not easily degraded. Residues have been found in soil, wildlife, fish, and food.

6. INTERCOMPARISON EXERCISE RESULTS

NS&T trace organic intercomparison exercises have been taking place since 1986. The exercise materials are distributed in the spring or early summer and the final results are collated and interpreted in late fall just before the annual QA Workshop. While only the NS&T laboratories have taken part in all the exercises since 1986, the overall number of participating laboratories has increased over the years.

The performance of "core" laboratories, those that have participated in the intercomparison exercises since the beginning of the QA Project, has improved with time. It is not possible, however, to document this statistically since different types of materials are used each year and the difficulty of the analyses has increased with time as the level of expertise of the participating laboratories has improved. Thus, possible analytical errors due to matrix interference, analyte level, and other variables have changed significantly from 1986 to 1990. Results of future exercises in which a number of similar natural materials will be analyzed may be useful in the evaluation of a laboratory's performance with time.

6.1. 1986 Exercises

The first NS&T trace organic intercomparison exercise took place in 1986 and was coordinated by NAF. At that time, NAF, the NOAA/NMFS/Southeast Fisheries Center (SEFSC), Charleston, SC, and the NOAA/NMFS/Northeast Fisheries Center (NEFSC), Gloucester, MA, were the NMFS laboratories cooperating in the NS&T National Benthic Surveillance Project (Table 6). BATTELLE, TAMU and Science Applications International Corporation (SAIC) were the contract laboratories for the Mussel Watch Program. NIST also participated in the exercise on a limited basis.

The materials used were prepared by NAF and were a sediment collected from the Duwamish Waterway (DUWAMISH III), and a tissue composite of tank-raised *Mytilus edulis* specimens exposed to contaminated water (MUSSEL II). The preparation of DUWAMISH III is described in MacLeod *et al.* (1982). The mussels used for MUSSEL II were collected and placed in seawater in a tank. Analytes of interest in a hexane solution and #2 fuel oil were added to the tank. The mussels were shucked approximately 16 hours later. The tissue was homogenized, placed in 18-mL liquid scintillation vials and stored at approximately -20°C (D. Brown, NOAA/NMFS/NWFSC/NAF, personal communication, 1992). The results of the 1986 exercise are listed in Appendix II.

Table 6. Laboratories participating in the NS&T Program for trace organic contaminant analyses.

Year					
	1986	1987	1988	1989	1990
Mussel Watch.....					
East Coast	BATTELLE	BATTELLE	BATTELLE	BATTELLE	BATTELLE
Gulf Coast	TAMU	TAMU	TAMU	TAMU	TAMU
West Coast	SAIC	SAIC	BATTELLE	BATTELLE	BATTELLE
National Benthic Surveillance.....					
East Coast	NEFSC	NAF	NAF	NAF	NAF
Gulf Coast	SEFSC	SEFSC	NAF	NAF	NAF
West Coast	NAF	NAF	NAF	NAF	NAF

BATTELLE: Battelle Ocean Sciences, Duxbury, MA.
 NAF: NOAA/NMFS/NWFSC/National Analytical Facility, Seattle, WA.
 NEFSC: NOAA/NMFS/Northeast Fisheries Center, Gloucester, MA.
 SAIC: Science Applications International Corporation, La Joya, CA.
 SEFSC: NOAA/NMFS/Southeast Fisheries Center, Charleston, SC.
 TAMU: Texas A&M University, College Station, TX.

6.1.1. DUWAMISH III sediment

The DUWAMISH III sediment material was characterized extensively by NAF prior to use in the NS&T program. This material was used during the development and evaluation of the analytical procedures described in MacLeod *et al.* (1985), and used in the initial NS&T analytical protocol.

To verify a laboratory's capability to properly use the NAF analytical protocol, triplicate samples of DUWAMISH III and an extensive set of tested internal and calibration standards prepared from a common supply were sent to the NS&T laboratories for analysis as part of the 1986 exercise. The analytical protocol described in MacLeod *et al.* (1985) was to be used by all the laboratories. Due to difficulties with the analytical procedure, the Mussel Watch laboratories repeated the exercise after first demonstrating the adequacy of their GC performance on tissue extracts. The Mussel Watch laboratories used modifications of the MacLeod *et al.* (1985) analytical protocol.

The results of the DUWAMISH III material analysis of PAHs are listed in Table II.1 (Appendix II). The PAH results are shown graphically in Figure 3. The results of the 2- and 3-ring PAHs (low molecular weight) and the 4- and 5-ring PAHs (high molecular weight) were summed to simplify interpretation. The results for the summed low molecular weight PAH concentrations showed good precision and were within the $\pm 30\%$ of the grand mean of the six individual means.

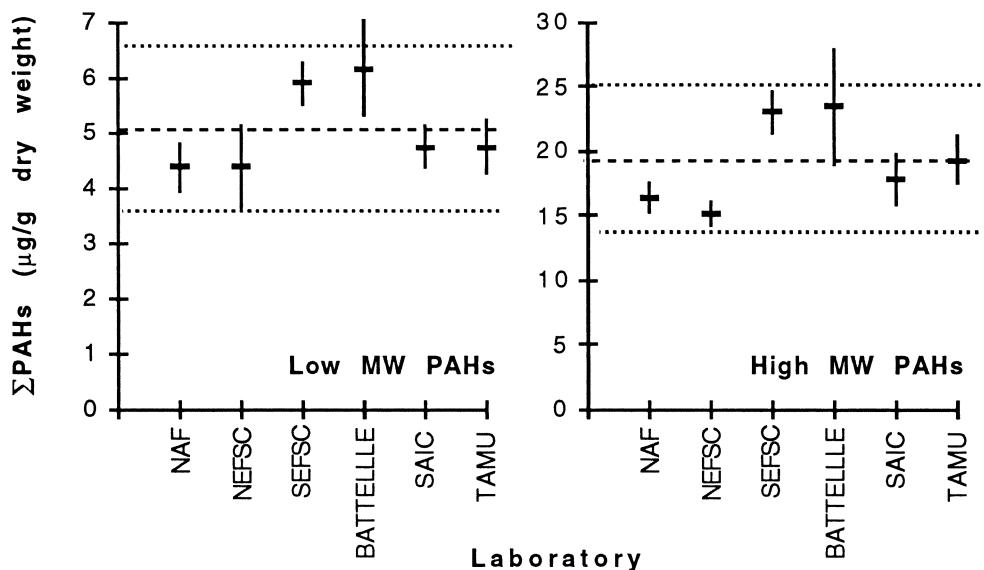


Figure 3. 1986 DUWAMISH III sediment intercomparison exercise results of polycyclic aromatic hydrocarbons analyses of three samples. (Dashed line is the grand mean of the triplicate analysis means of each laboratory. Dotted line is $\pm 30\%$ of the grand mean. Short horizontal bars are the sum of the low and high molecular weight PAHs as listed in Table 4, and vertical error bars are the linear sum of the standard deviations of PAH in each molecular weight category.) ($\mu\text{g/g}$ dry weight).

In this case, the grand mean and the $\pm 30\%$ limits were used as a guide, as there was no true or consensus value. The results for the summed high molecular weight PAH concentrations showed larger discrepancies in precision and accuracy. The results of limited PAH analysis by NIST using two independent methods of analysis: gas chromatography and liquid chromatography with fluorescence detection (Table II.4). The NIST data which were obtained using two different procedures, agree reasonably well with the exercise results (Figure 4). The largest discrepancies between the NIST values and those of the NS&T laboratories were observed for fluoranthene and pyrene. The relative standard deviations (RSD) of the PAH analyses replicates were between 2 and 23, except for one analyte result from one laboratory.

MacLeod and Brown (1986) subjected the results of the PAH analyses to principal component analysis and cluster analysis as performed by the CLUSTAN computer program (Everitt, 1980). CLUSTAN compares the results for each analyte (principal component) among all samples analyzed. Then, the cumulative dissimilarity for all analytes in a given sample with respect to those of all other samples is plotted on the ordinate of a graph and measured in terms of a "dissimilarity index." Thus, the lower on the ordinate that the CLUSTAN results of one sample

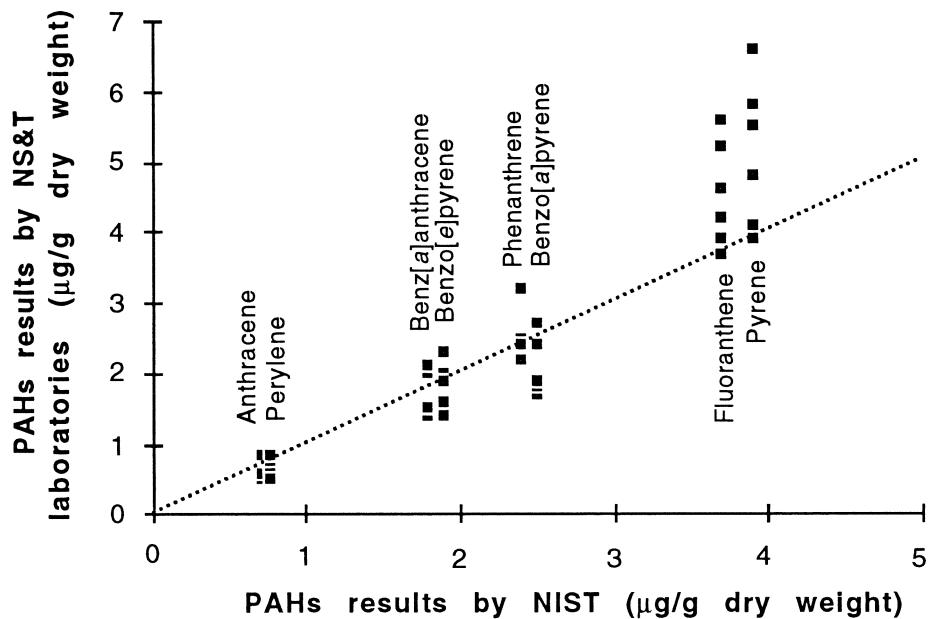


Figure 4. 1986 DUWAMISH III sediment intercomparison exercise results of polycyclic aromatic hydrocarbons analyses by NIST and NS&T laboratories using gas chromatography (Means of each of the six laboratories are shown. Dashed line has a slope of one.) ($\mu\text{g/g}$ dry weight).

cluster with those of another sample, the less dissimilar are the chemical analyses. The first clusters of the Duwamish III analyses CLUSTAN graph occurred mainly among the samples of a particular set of triplicates. Less expected, was the finding of little clustering according to whether a laboratory followed the MacLeod *et al.* (1985) protocol exactly (National Benthic Surveillance laboratories) or used a few controlled modifications (NIST and Mussel Watch laboratories).^{*} This shows that the modifications made by the Mussel Watch laboratories had minimal effect on the analytical results.

The results of the DUWAMISH III material analysis of PCBs are listed in Table II.2 and are shown graphically in Figure 5. The summed PCB data for each NS&T laboratory was within $\pm 30\%$ limits of the grand mean. As in the case of PAHs, there was no consensus value available. The standard deviations of the individual congener analyses replicates were below 30 except for analytes present in very low concentrations.

The results of the DUWAMISH III material analysis of pesticides are listed in Table II.3. The values reported were very low, many below the MDLs. Several laboratories did not submit data for all the analytes. Interpretation of this set of data was not possible.

* NIST and TAMU used GC/MS. Other laboratories used GC/FID.

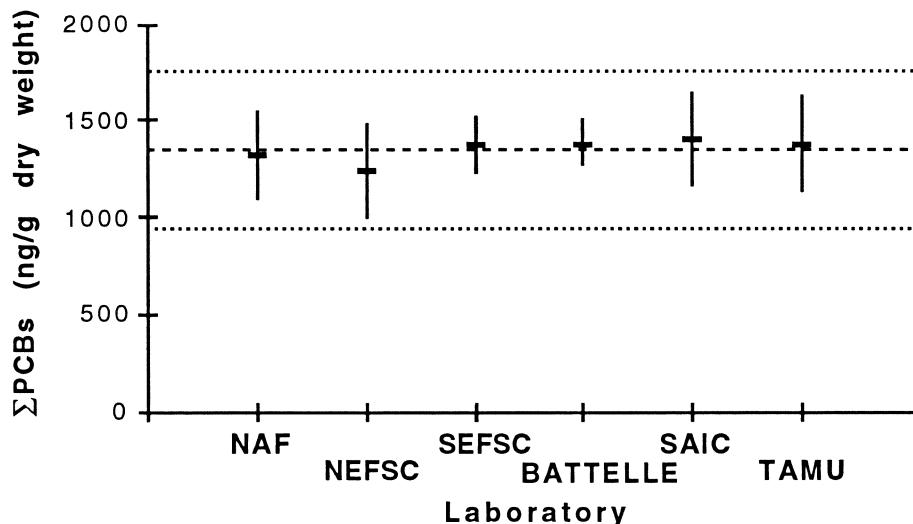


Figure 5. 1986 DUWAMISH III sediment intercomparison exercise results of polychlorinated biphenyls analyses of three samples (Dashed line is the grand mean of the triplicate analysis means of each laboratory. Dotted line is $\pm 30\%$ of the grand mean. Short horizontal bars are the sum of the PCBs at each level of chlorination, and vertical error bars are the linear sum of the standard deviations of each level of chlorination.) (ng/g dry weight).

6.1.2. MUSSEL II tissue

The results of the MUSSEL II material analyses of PAHs are listed in Table II.5 and shown graphically in Figure 6. The results of the low and high molecular weight PAHs were within the $\pm 30\%$ of the grand mean of the six individual means. In the case of DUWAMISH III, the grand mean and the $\pm 30\%$ limits were used as guides as there was no true or consensus value. The precision of the MUSSEL II tissue data submitted by some of the laboratories was worse than that of the DUWAMISH III sediment, with relative standard deviations of replicate analyses ranging overall up to 30%, with some higher exceptions. This difference in precision was due to effects of the more complex natural tissue matrix and has been previously observed.

The results of the MUSSEL II material analyses of PCBs are listed in Table II.6 and are shown graphically in Figure 7. Several laboratories failed to report values for some analytes, or reported values below the limit of detection. All available data for the PCB congeners was used to calculate the sum of the concentrations of the congeners. Zeroes were used for cases below the limit of detection or for missing data. The summed PCB data for four of the NS&T laboratories were within $\pm 30\%$ limits of the grand mean. One laboratory reported data below the lower limit, and another above. As in the case of PAHs, no consensus value was available.

The results of the MUSSEL II material pesticides determinations are listed in Table II.7. Several laboratories did not submit data for all the analytes. The relative standard deviations of many of the results were significantly large. Interpretation of this set of data was not possible. As in the case of the PCB analyses, several laboratories failed to report values for some analytes, or reported values below the limit of detection.

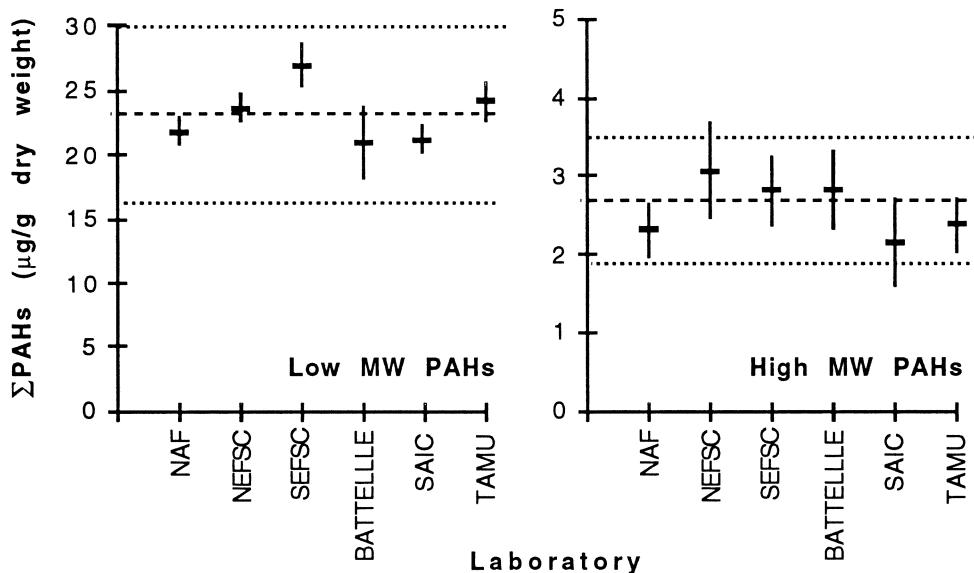


Figure 6. 1986 Mussel II intercomparison exercise results of polycyclic aromatic hydrocarbons analyses of three samples (Dashed line is the grand mean of the triplicate analysis means of each laboratory. Dotted line is $\pm 30\%$ of the grand mean. Short horizontal bars are the sum of the low and high molecular weight PAH results, and vertical error bars are the linear sum of the standard deviations of PAH in each molecular weight category.) ($\mu\text{g/g}$ dry weight).

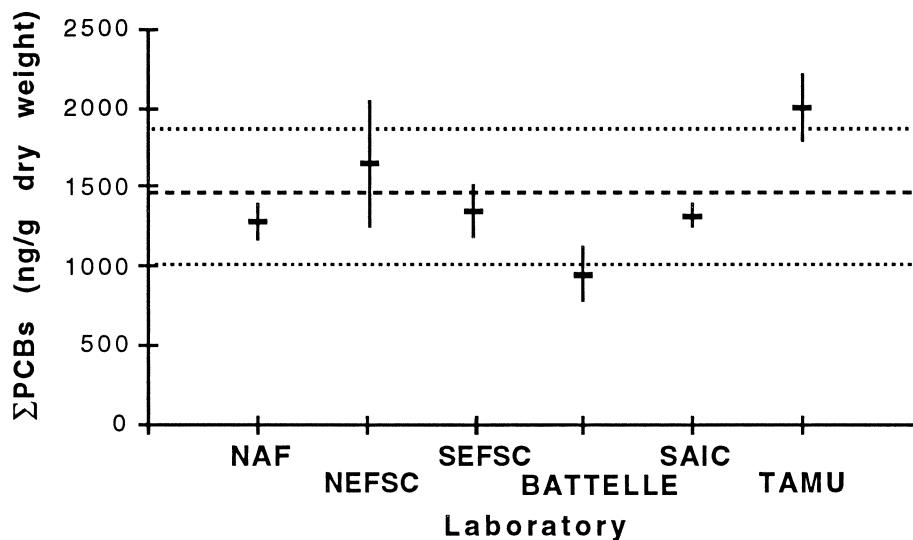


Figure 7. 1986 MUSSEL II tissue intercomparison exercise results of polychlorinated biphenyls analyses of three samples (Dashed line is the grand mean of the triplicate analysis means of each laboratory. Dotted line is $\pm 30\%$ of the grand mean. Short horizontal bars are the sum of the PCBs at each level of chlorination, and vertical error bars are the linear sum of the standard deviations of each level of chlorination.) (ng/g dry weight).

6.1.3. Comments

The intercomparison exercise was the first of the series organized for the NS&T Program. The contract and cooperating laboratories began modifications of the MacLeod *et al.* (1985) analytical procedure. The concentrations of many of the analytes of interest were below the MDLs achieved by the laboratories, thus making the results of the exercise difficult to interpret.

6.2. 1987 Exercises

The second intercomparison exercises took place in 1987 and were coordinated by NIST. By this time, laboratories were no longer required to use the method of MacLeod *et al.* (1985), and the NS&T QA Project changed to performance-based methods. NAF and the NMFS Southeast Fisheries Center (SEFSC), Charleston, NC, were the laboratories cooperating in the NS&T National Benthic Surveillance Program. BATTELLE, TAMU, and SAIC were the contractors for the Mussel Watch Program. A total of 8 laboratories, including NIST, submitted data. Two non-NS&T laboratories participated on a voluntary basis.

The materials used were a Baltimore Harbor sediment (Sed87) and a fresh frozen mussel tissue (Ti87) of specimens collected in Narragansett Bay, both prepared by NIST. The sediment was air-dried, pulverized, sieved to pass through a 100-mesh screen ($\leq 150 \mu\text{m}$), homogenized, and then aliquoted (~75 g) into glass bottles fitted with teflon-lined screw caps. The mussels used for Ti87 were collected close to the mouth of Narragansett Bay. The mussels were frozen and transported to NIST on dry ice. At NIST, the mussels were stored in a liquid nitrogen freezer (-120°C) until shucked at 0°C. The tissue was cryogenically pulverized, homogenized and aliquoted into clean, precooled glass bottles. The samples were then stored at -80°C until they were sent to the participating laboratories on dry ice.

The two materials were each analyzed in triplicate for PAHs, PCBs, and pesticides. Some laboratories reported PCB congener concentrations as well as PCB concentrations by chlorination level. However, the laboratories repeated the analyses throughout 1987, testing changes to their analytical procedures. The laboratories were asked to submit all their data, including that generated during testing of procedure modifications. The results are listed in Appendix III. The consensus values listed in the Appendix are the mean of all non-zero values reported by the laboratories for each analyte. Calibration solutions were prepared in isoctane or hexane toluene. NIST SRMs 1491, 1492, and 1493 were used as reference materials. Laboratories repeated the analyses throughout 1987, testing changes to their analytical procedures. The laboratories were asked to submit all their data, including that generated during testing of procedure modifications. No NS&T samples were analyzed during the process of evaluation of the analytical methods. No information is currently available on the nature of the method modifications evaluated during this exercise. The dates listed in Appendix III are the dates when data were received by NIST, not dates of analyses. Therefore, no data could be eliminated on the basis of unsuccessful methodology modifications or identified as being generated by the analytical procedure used to analyzed the NS&T samples. This exercise is not, necessarily, an indicator of laboratory performance.

6.2.1. Baltimore Harbor sediment

Although some of the data reported consisted of values below the detection limit, most individual PAHs could be quantified. The results are shown in Figure 8 and listed in Table III.1 (Appendix III). These modified procedures resulted in differences in LOQs for the analyses reported. The sum of the low and high molecular weight PAHs were mostly within $\pm 30\%$ of the consensus value.

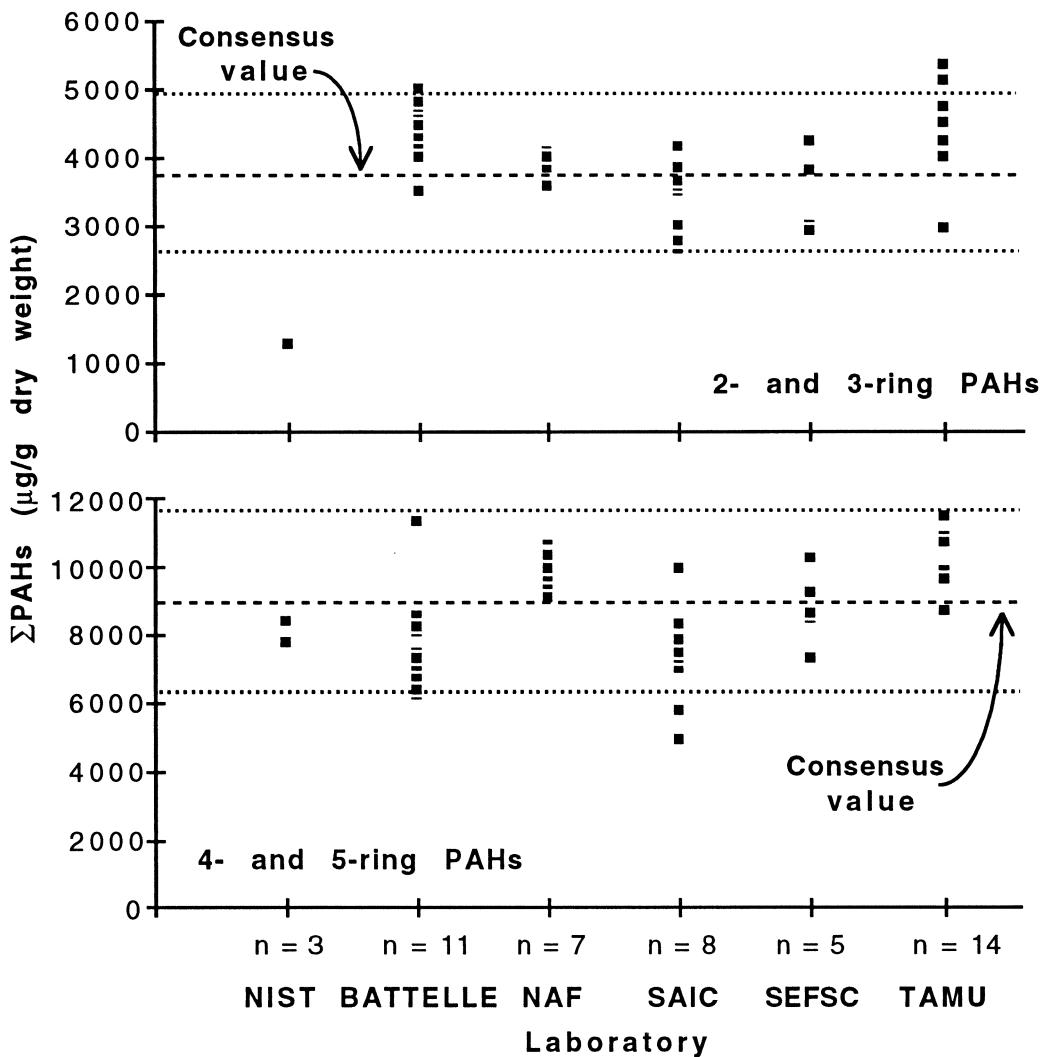


Figure 8. 1987 Analytical method evaluation polycyclic aromatic hydrocarbons results using Baltimore Harbor sediment (Sed87) ($\mu\text{g/g}$ dry wt.) (Dashed line is the consensus value. Dotted line is $\pm 30\%$ of the consensus value. The consensus value is the mean of all non-zero values reported by the laboratories. The number of samples analyzed by each laboratory is noted as n.).

The PCB congener analysis results of the Sed87 material are shown in Figure 9 and listed in Table III.2. As for the Mussel II mussel tissue analyses in 1986, there were various instances of observed peak interferences and possible misidentification of peaks in the gas chromatograms. Many values were not reported or were below the LOQs. The sum of the PCB congener concentrations were mostly within $\pm 30\%$ of the consensus value.

The pesticides analysis results of the Sed87 material are listed in Table III.3. Many of the reported concentrations were very low and close to the LOQs. Results of the DDT and metabolites, cyclopentadiene pesticides (Aldrin, *cis*-Chlordane, Dieldrin, heptachlor, heptachlor epoxide, and *trans*-Nonachlor), and hexachlorobenzene analyses are summarized in Figures 10,

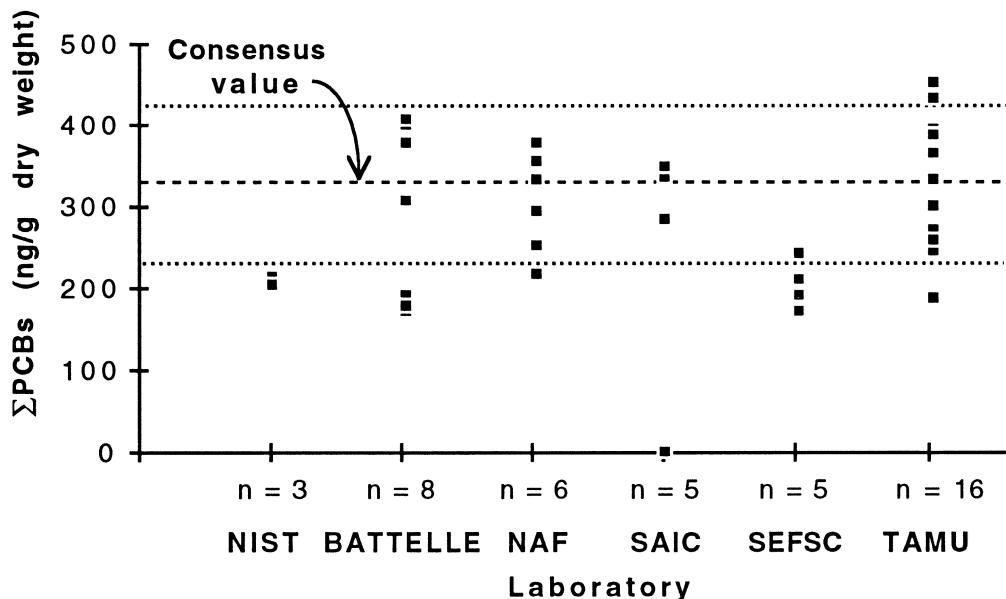


Figure 9. 1987 Analytical method evaluation polychlorinated biphenyls results using Baltimore Harbor sediment (Sed87) (ng/g dry wt.) (Dashed line is the consensus value. Dotted line is $\pm 30\%$ of the consensus value. The consensus value is the mean of all non-zero values reported by the laboratories. The number of samples analyzed by each laboratory is noted as n.).

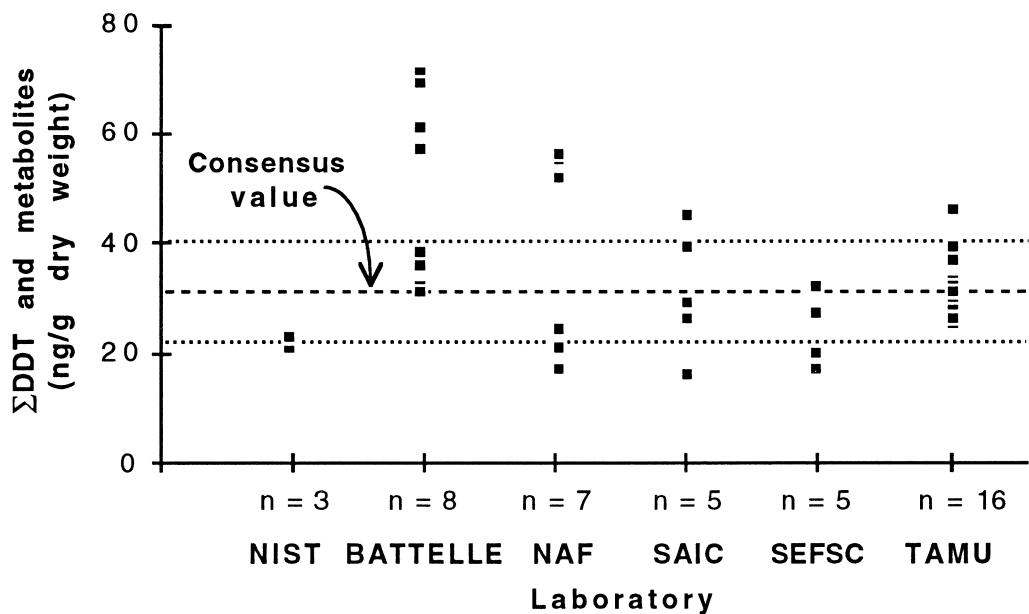


Figure 10. 1987 Analytical method evaluation DDT and metabolites results using Baltimore Harbor sediment (Sed87) (ng/g dry wt.) (Dashed line is the consensus value. Dotted line is $\pm 30\%$ of the consensus value. The consensus value is the mean of all non-zero values reported by the laboratories. The number of samples analyzed by each laboratory is noted as n.).

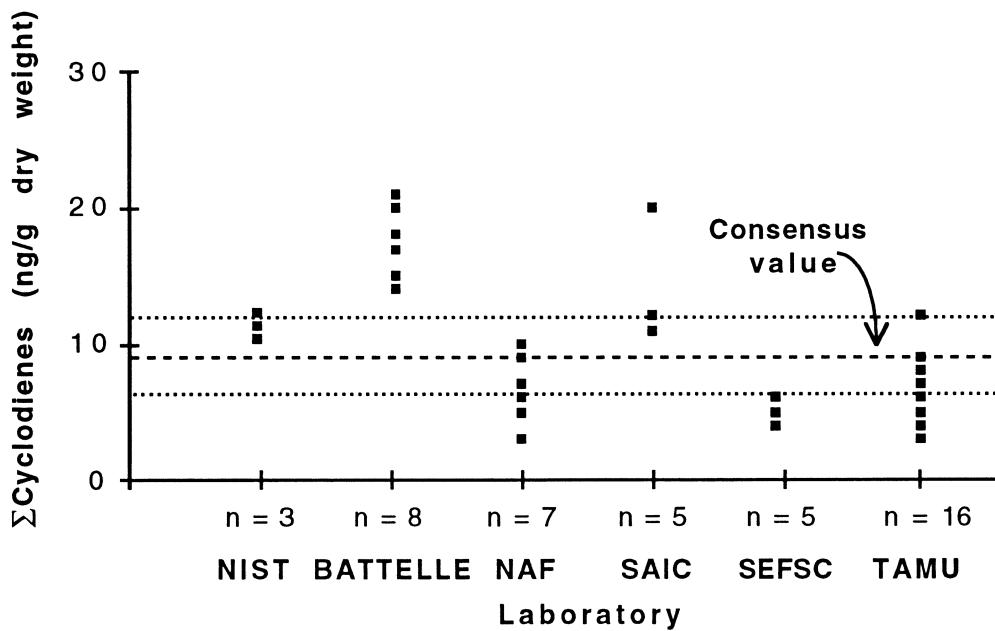


Figure 11. 1987 Analytical method evaluation cyclopentadiene pesticides results using Baltimore Harbor sediment (Sed87) (ng/g dry wt.) (Dashed line is the consensus value. Dotted line is $\pm 30\%$ of the consensus value. The consensus value is the mean of all non-zero values reported by the laboratories. The number of samples analyzed by each laboratory is noted as n.).

11 and 12. The concentrations of the other pesticides were mostly below the LOQs or not reported.

As in the case of the PAH and PCB analyses, values for many analytes were not reported or were below the LOQs. A significant number of values were reported as zero or below the LOQs and in many cases no values were reported for some analytes. In general, the range of reported concentrations for the pesticides is much larger than those reported for the PAHs and PCBs.

6.2.2. Narragansett Bay mussel tissue

The PAHs in the Ti87 material were very low and most of the data reported consisted of values below the LOQs (Table III.4). The PCB congener analysis results of the Ti87 material are listed in Table III.5 and the sum of the concentrations of the PCB congeners are shown in Figure 13. There were various instances of observed peak interferences and possible misidentification of peaks in the gas chromatograms. Values were not reported for many analytes or were below the LOQs. Most of the total PCB concentrations were within $\pm 30\%$ of the consensus values. The results of DDT and metabolite compounds and the cyclopentadiene pesticides are shown in Figures 14 and 15 respectively. As in the case of Baltimore Harbor sediment analysis (Sed87), the range of concentrations is large and many values were outside $\pm 30\%$ of the consensus value. The concentrations of the other pesticides were mostly below the LOQs or not reported.

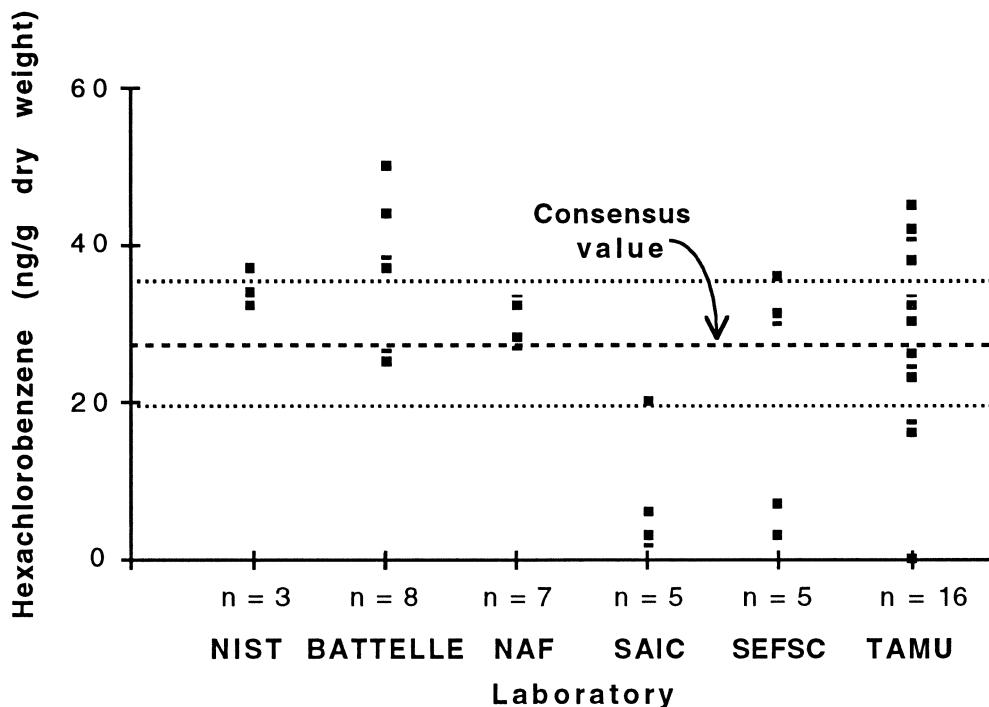


Figure 12. 1987 Analytical method evaluation hexachlorobenzene results using Baltimore Harbor sediment (Sed87) (ng/g dry wt.) (Dashed line is the consensus value. Dotted line is $\pm 30\%$ of the consensus value. The consensus value is the mean of all non-zero values reported by the laboratories. The number of samples analyzed by each laboratory is noted by each laboratory.).

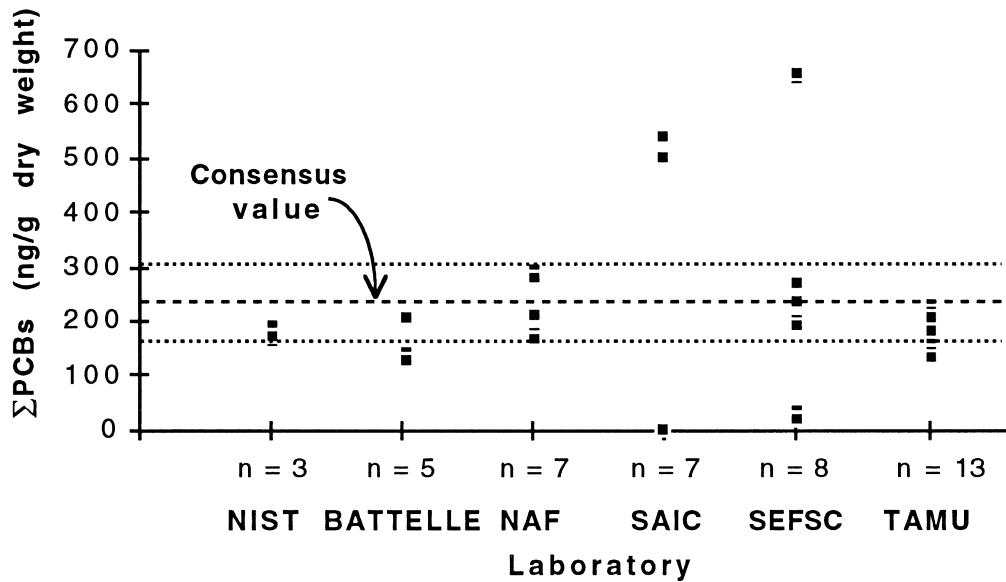


Figure 13. 1987 Analytical method evaluation polychlorinated biphenyls results using Narragansett Bay mussel tissue (Ti87) (ng/g dry wt.) (Dashed line is the consensus value. Dotted line is $\pm 30\%$ of the consensus value. The consensus value is the mean of all non-zero values reported by the laboratories. The number of samples analyzed by each laboratory is noted as n.).

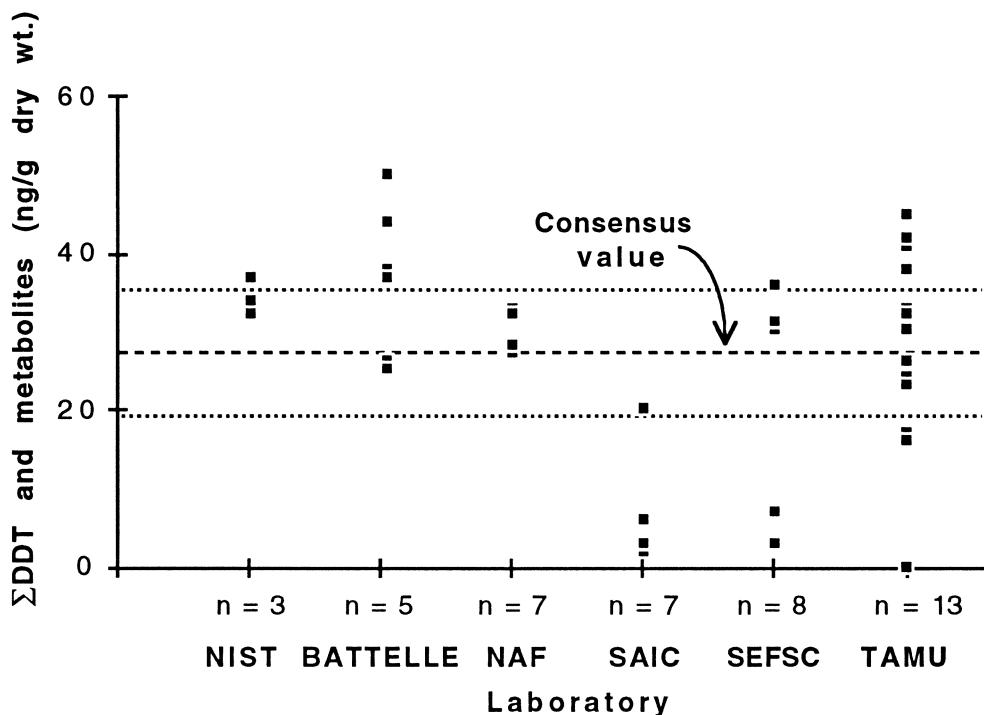


Figure 14. 1987 Analytical method evaluation DDT and metabolites results using Narragansett Bay mussel tissue (Ti87) (ng/g dry wt.) (Dashed line is the consensus value. Dotted line is $\pm 30\%$ of the consensus value. The consensus value is the mean of all non-zero values reported by the laboratories. The number of samples analyzed by each laboratory is noted as n.).

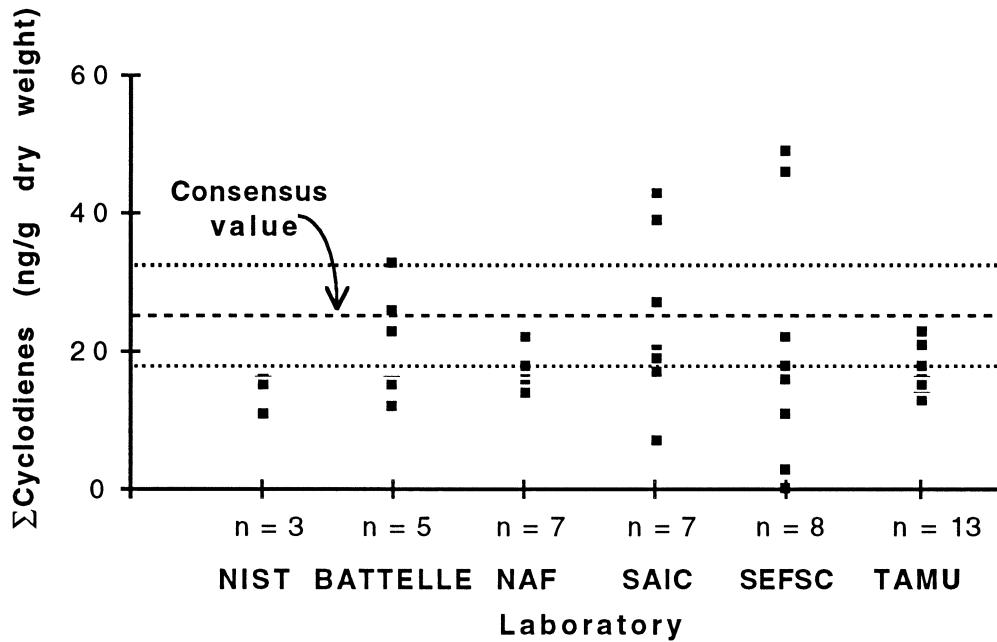


Figure 15. 1987 Analytical method evaluation cyclopentadiene pesticides results using Narragansett Bay mussel tissue (Ti87) (ng/g dry wt.) (Dashed line is the consensus value. Dotted line is $\pm 30\%$ of the consensus value. The consensus value is the mean of all non-zero values reported by the laboratories. The number of samples analyzed by each laboratory is noted as n.).

6.2.3. Comments

Statistical interpretation of the results was not possible or was complicated by:

- A large portion of the data reported were below the LOQs
- Interferences were reported in chromatograms, and identification of analyte peaks in chromatograms is in question in some cases
- No "true" or certified concentration values were available, only consensus values based on data generated during evaluation of analytical methodology
- Laboratories reported different numbers of data points thus possibly biasing the consensus value by the results of that laboratory

The results of the 1987 exercise are not an indication of laboratory performance. During that time, analytical method modifications were being tested and no information is currently available on the nature of these modifications or on which set of results were generated using the analytical method used for analysis of the NS&T samples.

6.3. 1988 Exercises

Due to the problems encountered during the 1987 exercise, a series of solutions were used for the 1988 exercise instead of the more complex natural matrix materials. These solutions were the first step in a series of exercises designed to help to isolate the sources of variability and bias in the analyses such as the extraction and concentration steps. The 1988 exercise was used to evaluate instrumental variability. The participating laboratories were informed of the number and identity of analytes in the solutions.

The 1988 exercise was coordinated by NIST. Three solutions were used that mimicked the relative amounts of analytes in real sample.* The actual concentrations, however, were much larger than the MDLs. The solutions were prepared gravimetrically at NIST. They were: PAHs in hexane and toluene (VAR-PAH); PCBs in 2,2,4-trimethylpentane (VAR-PCB); and pesticides in hexane (VAR-PES). The list of analytes in VAR1-PCB, VAR1-PES and VAR1-PAH was provided to the laboratories. The laboratories were asked to analyze the contents of one of the ampoules in triplicate (i. e., three GC injections), and the other two ampoules were analyzed once. The results are listed in Appendix IV. NIST SRM 1491, 1492 and 1493 were used for calibration.

* The following considerations were used to calculate the appropriate concentration goals for the components of these materials. First, results of the determination of these analytes in various tissue samples were compiled. Initial relative concentration goals for the components of each solution were obtained from average concentrations from this data compilation. The relative concentration targets for PCB congeners were then adjusted to reflect the presence of the lower chlorinated mixtures as Aroclor 1242 as are typically found in sediment samples, as well as the more highly chlorinated congeners as in Aroclor 1260 that are seen in tissue samples. Since the PAH data compiled showed fewer trends and limited data were available for some of these analytes, the concentrations of some of the VAR-PAH components were just varied arbitrarily. The relative concentration targets for each of the three solutions were further adjusted so that the relative concentrations within each solution were within a 50-fold range. Absolute concentrations were then calculated from these relative concentrations by setting the component of lowest relative concentration in each solution at a concentration which would yield a signal peak approximately 20 times the noise level when 1 μ L (VAR-PEST and VAR-PCB) was injected in the split mode on a GC/ECD or 2 μ L (VAR-PAH) was injected splitless on a GC-FID instrument. The concentration of each component was adjusted for the purity of each component used. Purities were estimated from analyses of solutions of individual components by GC-FID and, in some cases, of the neat component material by differential scanning calorimetry. The concentrations of the components in each of these solutions was confirmed by NIST gas chromatographic analyses.

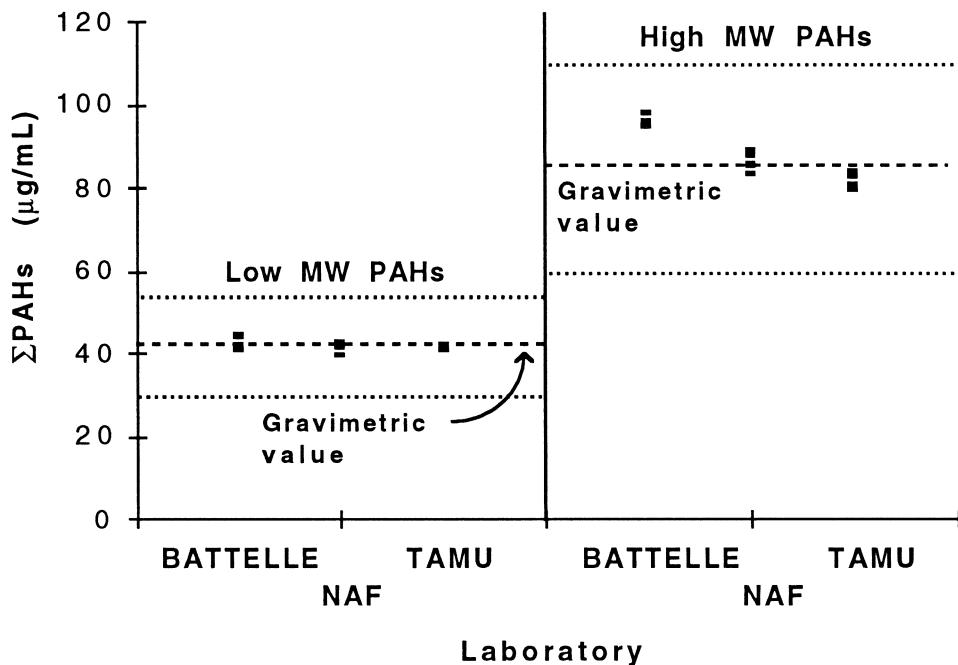


Figure 16. 1988 Polycyclic aromatic hydrocarbons in hexane and toluene gravimetric solution [QA88S1AH (VAR-PAH)] intercomparison exercise analysis results of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value) ($\mu\text{g}/\text{mL}$).

In 1988, the laboratories employed by NS&T changed. Only three laboratories previously used by NS&T (NAF, BATTELLE and TAMU) participated in the exercise. A total of eight laboratories, including NIST, submitted data. Some laboratories repeated the exercise and only the last set of data is included in this report. Four non-NS&T laboratories participated on a voluntary basis.

6.3.1. PAHs in hexane and toluene (VAR-PAH)

The PAH data are listed in Table IV.1 (Appendix IV), and summarized graphically in Figure 16. The results of the 2- and 3-ring PAHs (low molecular weight) and the 4- and 5-ring PAHs (high molecular weight) were summed to simplify interpretation. The results of the summed low molecular weight PAH results show good precision and accuracy, and are within the $\pm 30\%$ of the NIST gravimetric value. The accuracy of the high molecular weight PAH results was less than that of the low molecular weight PAHs, but the precision was comparable. The results were within the $\pm 30\%$ envelope. The mean absolute percent error is an accuracy indicator and is the mean of the absolute percent errors of the three sample replicates relative to the NIST gravimetric value. The percent relative standard deviation (%RSD) of these replicates is a precision indicator. These parameters are found in all subsequent tables in the appendices for both the "within the same sample data" (same ampoule), and "between the three ampoules" data. The RSDs were well below 10% in most cases.

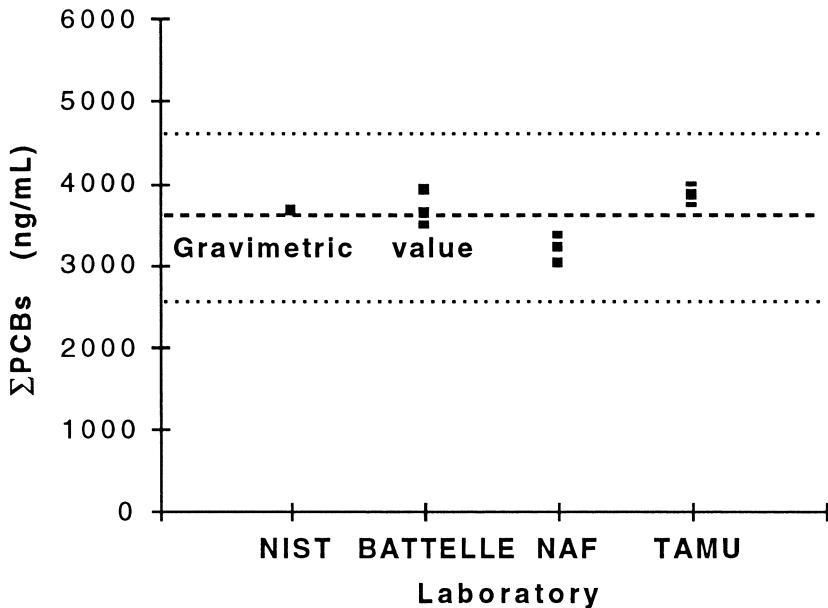


Figure 17. 1988 Gravimetric solution [QA88S1CB (VAR-PCB)] intercomparison exercise results of polychlorinated biphenyls of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

6.3.2. PCB congeners in 2,2,4-trimethylpentane (VAR-PCB)

The PCB data are listed in Table IV.2 and summarized graphically in Figure 17 using the sum of the congener concentrations. The NIST gravimetric values used to prepare the solutions were used as the accepted values. The best precision was obtained by NIST. All results show good accuracy and precision and are within the $\pm 30\%$ envelope. The RSDs were below 10% and most were below 5. More variation in RSDs was observed in the PCB data than in that of PAHs.

6.3.3. Pesticides in hexane (VAR-PES)

The pesticide data are listed in Table IV.3. NIST provided analysis results of the pesticide solution as well as gravimetric values. The results of the DDT and metabolite analyses are shown in Figure 18. Although the results are within the $\pm 30\%$ envelope, the precision was not as good as previously observed. The results of the cyclopentadiene pesticides (Aldrin, *cis*-Chlordane, Dieldrin, heptachlor, heptachlor epoxide and *trans*-Nonachlor) determinations are shown in Figure 19, and show good accuracy and precision. The results of the determination of

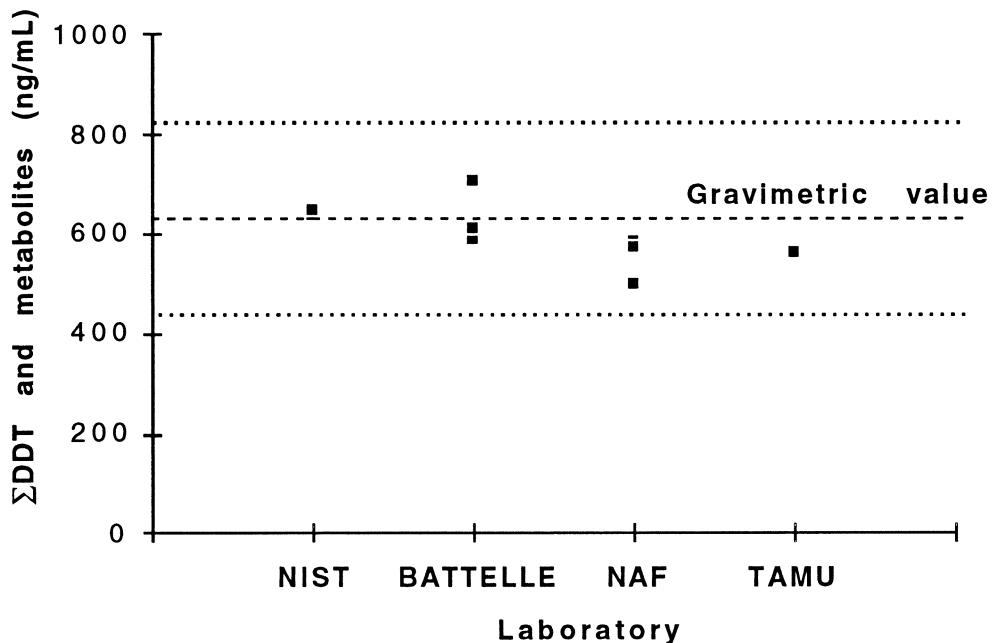


Figure 18. 1988 Gravimetric solution [QA88S1PE (VAR-PES)] intercomparison exercise results of DDT and metabolites analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

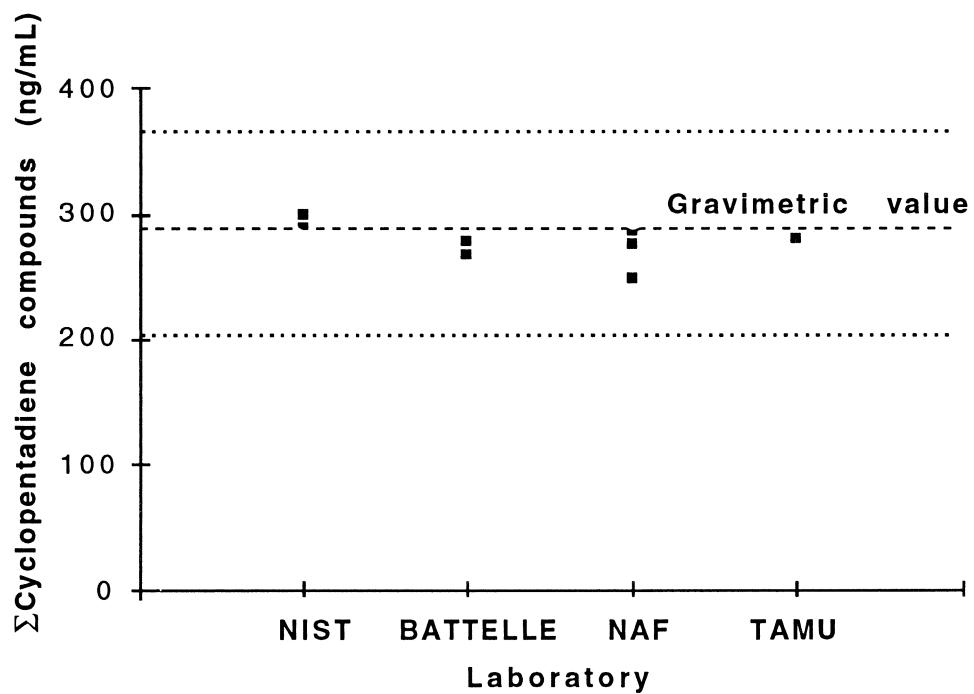


Figure 19. 1988 Gravimetric solution [QA88S1PE (VAR-PES)] intercomparison exercise results of cyclopentadiene pesticides of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

Mirex (Figure 20), hexachlorobenzene (Figure 21), and gamma-HCH (Figure 22) showed greater variation in precision and accuracy. Except for the results of the determination of gamma-HCH by NAF, which are slightly below the lower limit, the results were within the $\pm 30\%$ envelope. It must be noted that the envelope limits for single compounds are $\pm 35\%$, thus extending the boundaries (Section 4.1.6). As for the PCB data, the RSDs were below 10% and most were below 5%.

6.3.4. Comments

The results of the 1988 exercise demonstrated that the NS&T laboratories could identify the compounds used in the exercise in the chromatograms and could quantitate them within the limits specified by the NS&T Program. The accuracy and precision, however, could be improved. At the 1988 QA Workshop, it was decided to use another set of solutions with different concentrations and a frozen oyster tissue homogenate for the 1989 exercise.

6.4. 1989 Exercises

The 1989 exercises were coordinated by NIST. The materials used were gravimetric solutions QA89S1PE (VAR2-PES, pesticides in hexane), QA89S1CB (VAR2-PCB, PCBs in 2,2,4-Trimethylpentane), and QA89S1AH (VAR2-PAH, PAHs in hexane and toluene); and a frozen oyster tissue homogenate of specimens collected in the Gulf of Mexico (QA89T1). Each of the gravimetric solutions contained all the NS&T analytes of interest in the listed chemical class and the participating laboratories were aware of the identity of the analytes used. The solutions were prepared gravimetrically using the same procedure as that of the VAR solutions used for the 1988 exercises except that the concentration of each component was varied by 5-10%

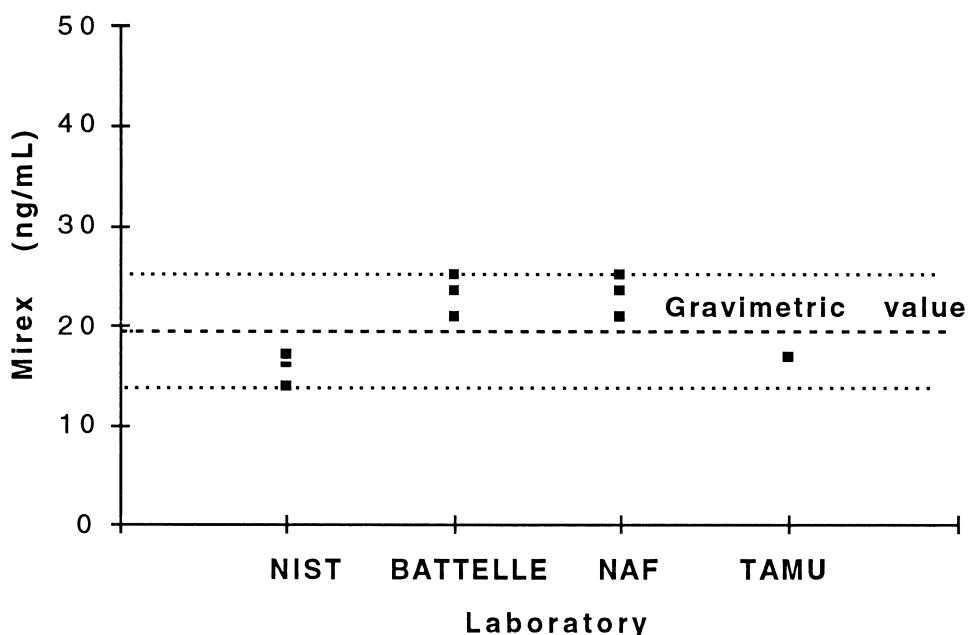


Figure 20. 1988 Gravimetric solution [QA88S1PE (VAR-PES)] intercomparison exercise analysis results of Mirex analyses of three samples (Dashed line is gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

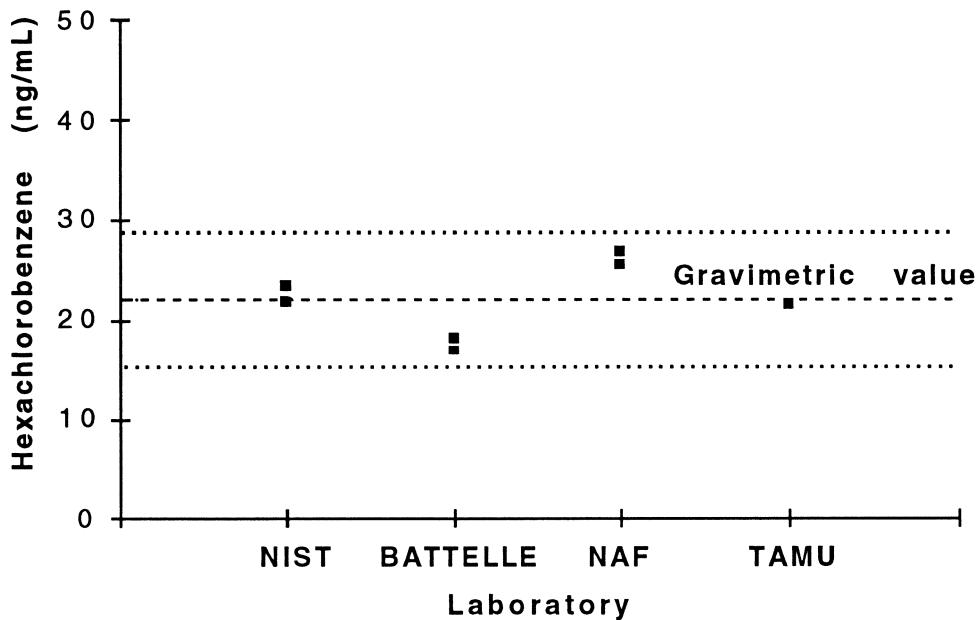


Figure 21. 1988 Gravimetric solution [QA88S1PE (VAR-PES)] intercomparison exercise results hexachlorobenzene analyses of three samples (Dashed line is gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL)

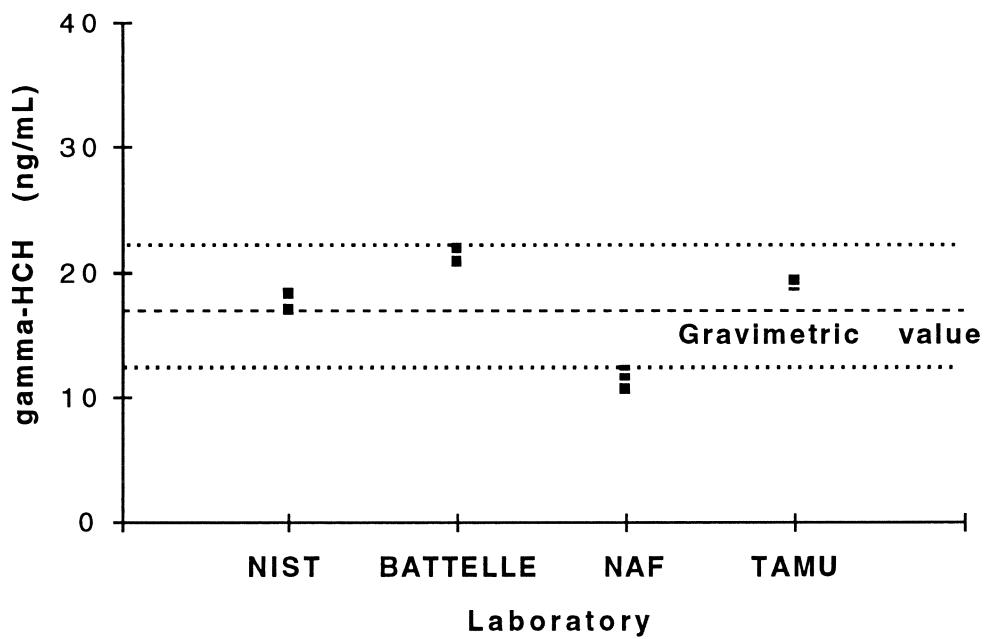


Figure 22. 1988 Gravimetric solution [QA88S1PE (VAR-PES)] intercomparison exercise results of gamma-HCH analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

either positively or negatively. The list of analytes in VAR2-PCB, VAR2-PES, and VAR2-PAH was provided to the laboratories. The oyster tissue which had been stored frozen at an NS&T laboratory was shipped to NIST on dry ice. At NIST, the tissue was cryogenically pulverized, homogenized and aliquoted into clean, precooled glass bottles. The samples were then stored at -80°C until they were sent to the participating laboratories on dry ice.

The laboratories were asked to analyze one of the solutions in triplicate (i. e., three GC injections), and the other two extracts were analyzed once. The results are listed in Appendix V. No NAF data for the triplicate analysis of the same ampoule is available. The control materials used were a sediment from Baltimore Harbor (Sed87) and a mussel tissue from specimens collected in Baltimore Harbor (Ti88). The materials used for calibration were SRMs 2261, 2262, and 2260. NAF, BATTELLE, and TAMU participated in the exercise and ten other laboratories participated on a voluntary basis. In addition, some of the NS&T laboratories participated in the International Council for the Exploration of the Seas (ICES) PCBs intercalibration exercise.

6.4.1. PAHs in hexane and toluene (VAR2-PAH)

The PAH mixture solution in hexane/toluene was prepared gravimetrically at NIST. All the laboratories identified the 24 compounds in the chromatograms. The results of the PAH analyses are listed in Table V.1 (Appendix V), and summarized graphically in Figure 23. The results of the 2- and 3-ring PAHs (low molecular weight) and the 4- and 5-ring PAHs (high molecular weight) were summed to simplify interpretation. The results of the summed low and high molecular weight PAH determinations showed good precision and accuracy, and were within the $\pm 30\%$ envelope of the NIST gravimetric value. The RSDs were below 10% and well below 5% in many cases.

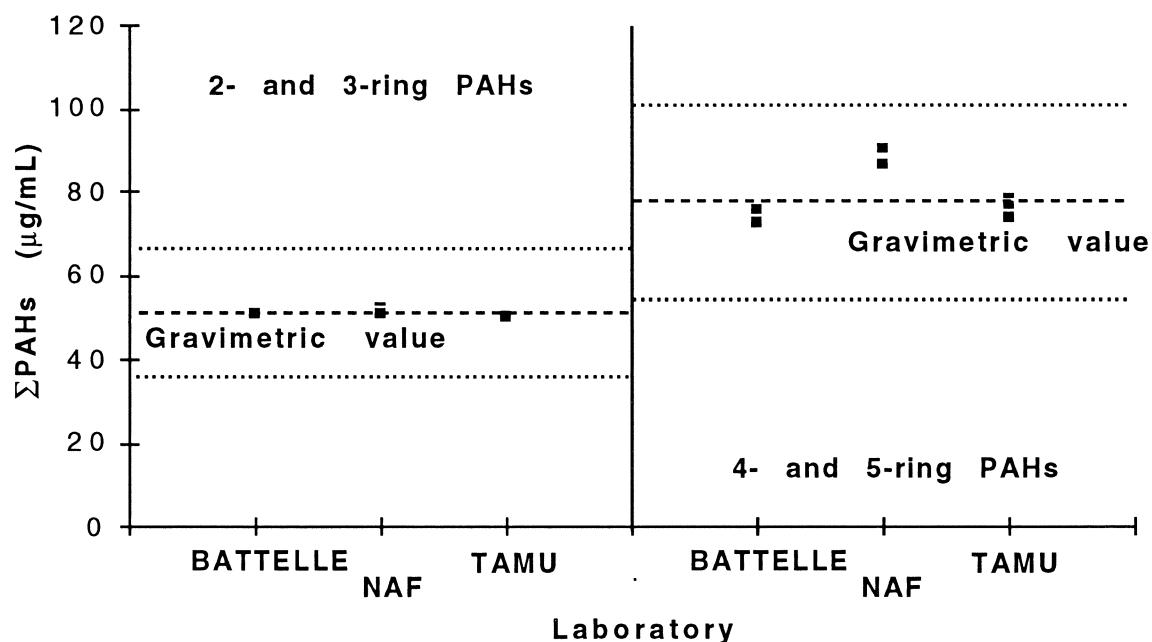


Figure 23. 1989 Gravimetric solution [QA89S1AH (VAR2-PAH)] intercomparison exercise results of polycyclic aromatic hydrocarbons analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) ($\mu\text{g/mL}$).

6.4.2. PCBs in 2,2,4-trimethylpentane (VAR2-PCB)

The PCB mixture solution in 2,2,4-trimethylpentane was prepared gravimetrically at NIST. Each of the laboratories identified the 18 congeners in the chromatograms. The PCB results are listed in Table V.2 and summarized graphically in Figure 24. The total PCB congener concentrations were within the $\pm 30\%$ envelope of the NIST gravimetric value. The precision was better than that of the 1988 exercise. The RSDs were below 10% in most cases.

6.4.3. Pesticides in hexane (VAR2-PES)

The pesticide mixture solution in hexane was prepared gravimetrically at NIST. The pesticide data are listed in Table V.3. The results of the DDT and metabolite analyses are summarized in Figure 25. The sum of the concentrations of all six compounds is used for clarity. All were within the $\pm 30\%$ envelope of the NIST gravimetric value. The results of the cyclopentadiene (Aldrin, *cis*-Chlordane, Dieldrin, heptachlor, heptachlor epoxide, and *trans*-Nonachlor) pesticides analyses are shown in Figure 26. The sums of the concentrations reported for the six cyclopentadiene compounds were used for clarity. The precision was good but the accuracy varied from laboratory to laboratory. The results were within the $\pm 30\%$ envelope of the NIST gravimetric value.

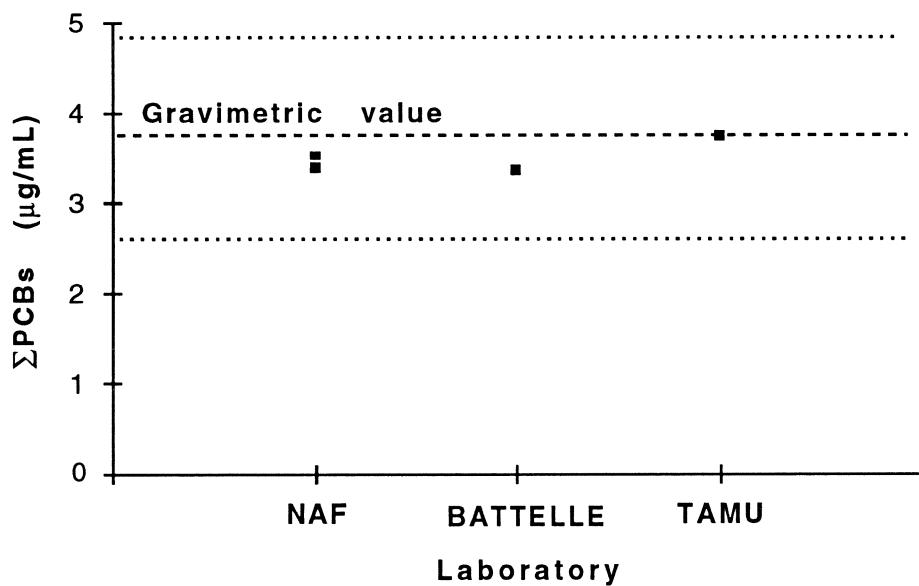


Figure 24. 1989 Gravimetric solution [QA89S1CB (VAR2-PCB)] intercomparison exercise results of polychlorinated biphenyl analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) ($\mu\text{g/mL}$).

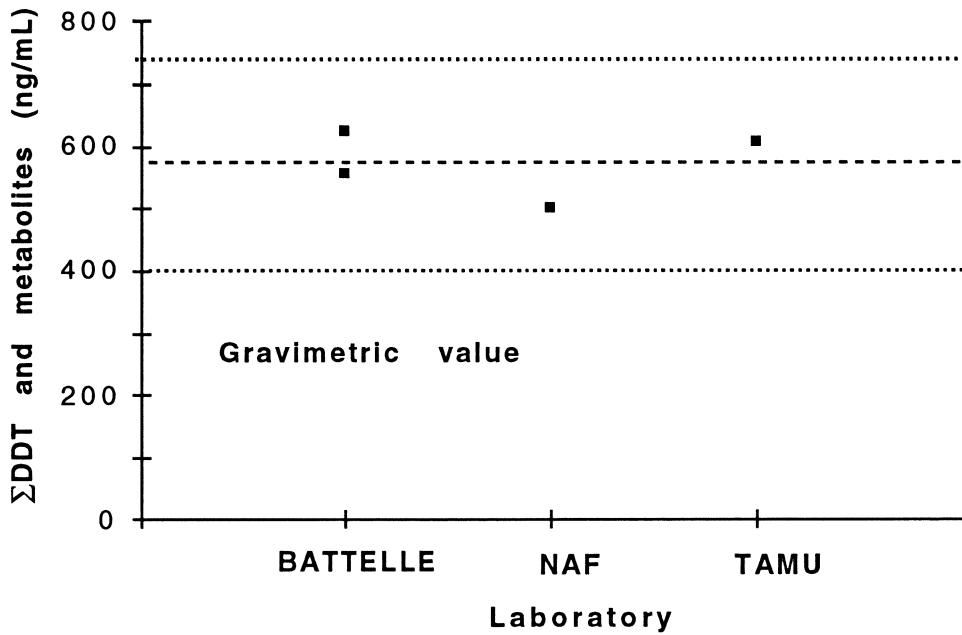


Figure 25. 1989 Gravimetric solution [QA89S1PE (VAR2-PES)] intercomparison exercise results of DDT and metabolite analyses of three samples (ng/mL) (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of gravimetric value.).

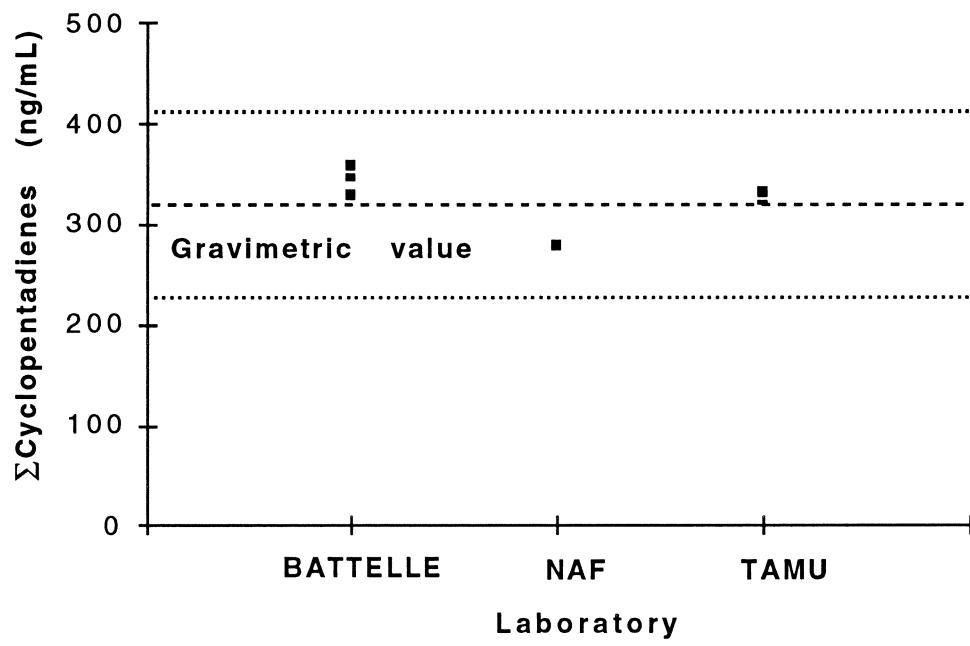


Figure 26. 1989 Gravimetric solution [QA89S1PE (VAR2-PES)] intercomparison exercise results of cyclopentadiene pesticides analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

The results of the hexachlorobenzene, Mirex and gamma-HCH analyses are shown in Figures 27, 28, and 29. The precision of all these analyses was good, but the accuracy was not as good as previously observed. The results are within the $\pm 30\%$ envelope of the NIST gravimetric value.

6.4.4. Oyster tissue homogenate (QA89T1)

The results of the analyses of the frozen oyster tissue (QA89T1) are listed in Table V.4. The oyster material used to prepare QA89T1 were remainders of oyster samples provided to NIST by an NS&T laboratory. The laboratories participating in the exercises described the QA89T1 as being atypical. Laboratories had to use additional cleanup steps, more selective analysis, and/or extract data from very atypical chromatograms in order to obtain concentration data for submission. A large number of "negative peaks" were observed in the ECD chromatograms, and the FID chromatograms had many more peaks than usually observed during analysis of oyster or mussel samples. Chemists at the annual QA meeting reported the presence of large numbers of oxygenated species in QA89T1 as would result during decay of the sample. It was agreed during this meeting that data from this exercise would not be used as a mechanism to assess the quality of results NS&T oyster and mussel analysis, and that this material would not be further analyzed. Both sample and methods used were atypical of those used in the NS&T Program.

6.4.5. ICES first step

In 1989, ICES organized an ICES/IOC/OSPARCOM multi-year PCB congener intercomparison exercise in marine media among 61 laboratories. A complete description of the exercise and results can be found in De Boer *et al.* (1990). The NS&T laboratories were invited to participate and BATTELLE and TAMU did so on a voluntary basis. NIST also participated in the exercise. For the first step of the exercise, ICES sent ampoules of a solution "B" to be analyzed and ampoules of a solution "A" to use as a calibrant. The laboratories were told to use 750 ng/mL as the concentration of each PCB congener in solution "A" except for PCB 52 which was assigned 791 ng/mL. The exercise coordinators stated that solution "B" was a ten-fold dilution of solution "A". They also were aware that the gravimetric concentrations of solution "A" deviated from the nominal concentration of 750 ng/mL but that everyone using the same calibration solution concentrations would be working on the same scale. Participants were warned not to use this solution for any other analyses.

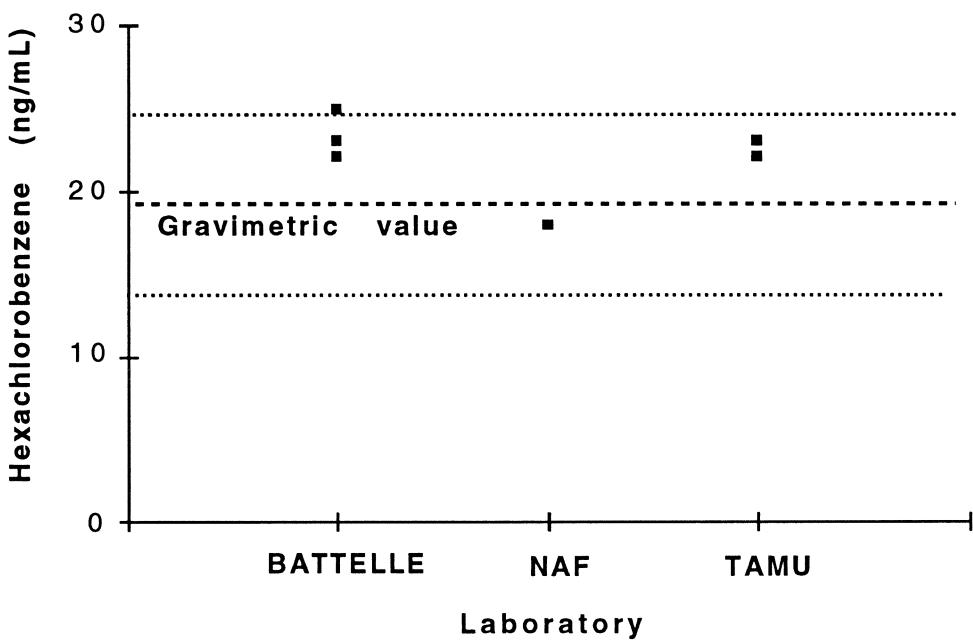


Figure 27. 1989 Gravimetric solution [QA89S1PE (VAR2-PES)] intercomparison exercise results of hexachlorobenzene analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

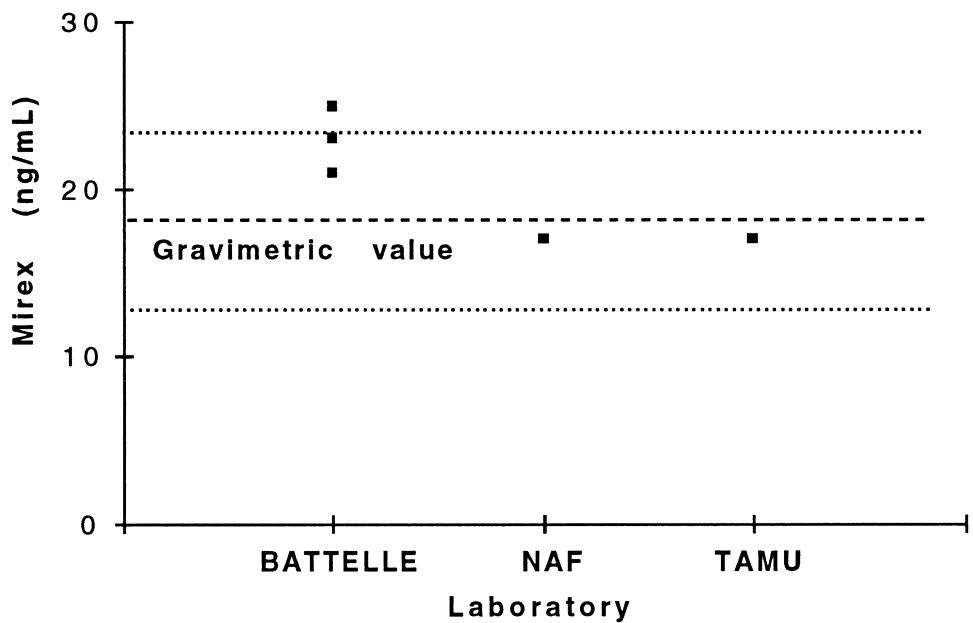


Figure 28. 1989 Gravimetric solution [QA89S1PE (VAR2-PES)] intercomparison exercise results of Mirex analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

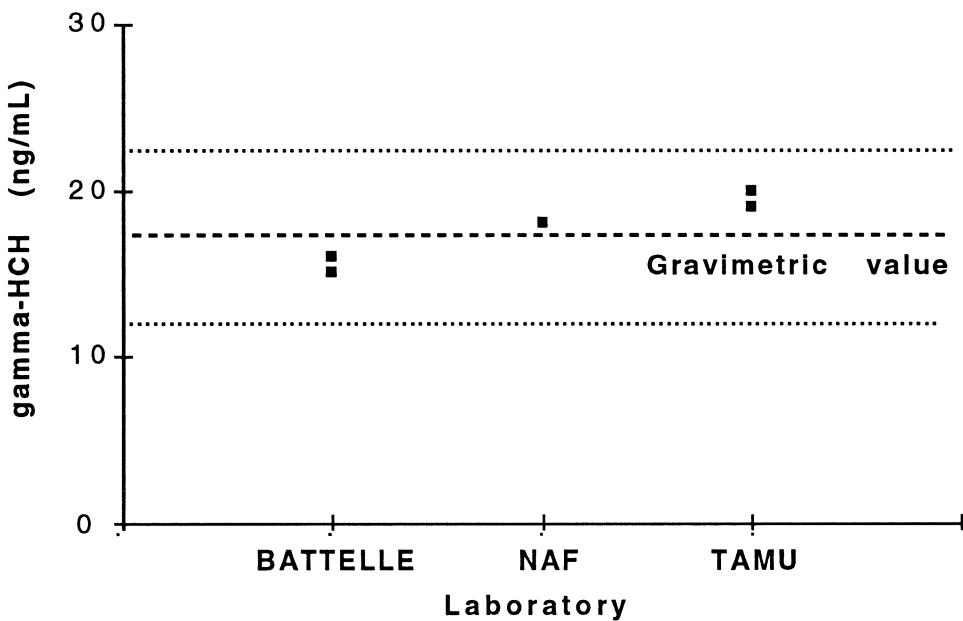


Figure 29. 1989 Gravimetric solution [QA89S1PE (VAR2-PES)] intercomparison exercise results of gamma-HCH analyses of three samples. (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

The participating laboratories were asked to use both polar and non-polar columns during the exercise. The results are listed in Table V.5 and are shown in Figure 30. The results of the analyses by NIST, BATTELLE, and TAMU were within the $\pm 30\%$ envelope except for those of PCB 52, PCB 101 and PCB 118 using the non-polar column. The RSDs were below 10% in all cases.

6.4.6. Comments

The results of the 1989 intercomparison exercise analyses of the gravimetric solutions are summarized graphically in Figures 31, 32, and 33. For each laboratory and analyte, the ratio of the analytically determined mean value of three samples to gravimetric value was calculated. The limits of $\pm 30\%$ would result in ratios between 0.7 and 1.3. All the PAH and PCB analyses results were within the $\pm 30\%$ limit except for the results of benzo[e]pyrene, benzo[k]fluoranthene and perylene by NAF. The results of the pesticide analyses were within the $\pm 30\%$ limit with the exception of the 2,4'-DDD and heptachlor results by NAF.

The results of the three VAR2 solutions and ICES showed good precision and accuracy. The results obtained from the frozen oyster tissue showed more variability and could be the result of the physical state of the samples.

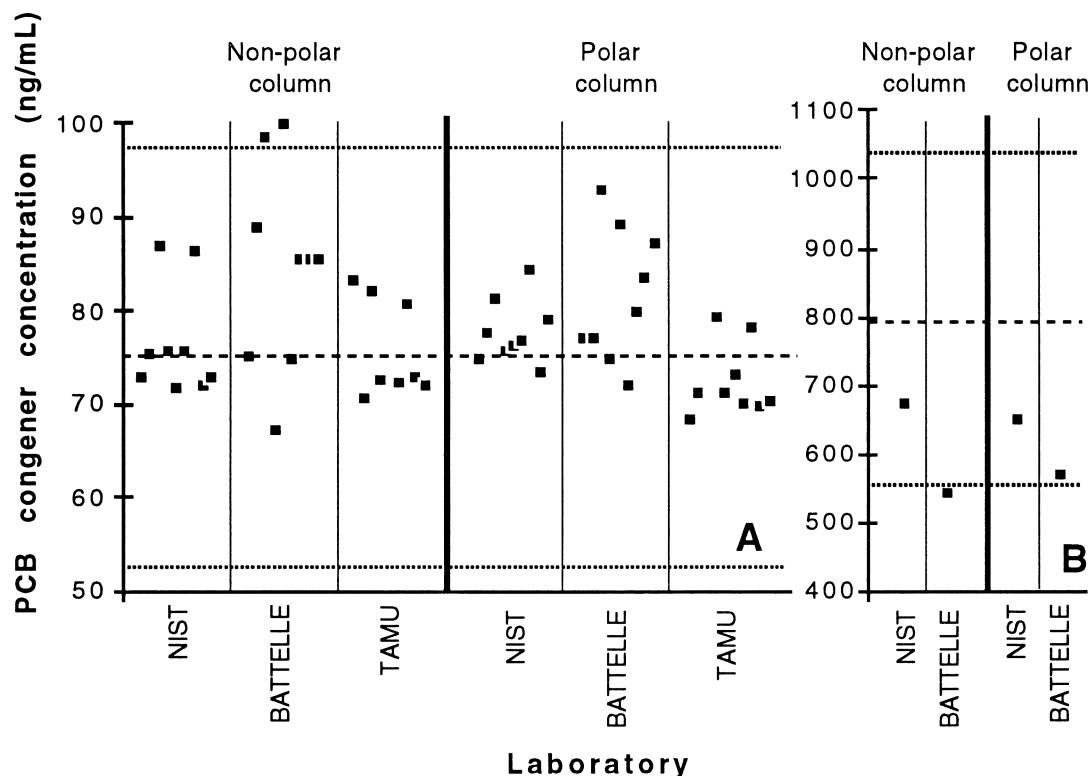


Figure 30. 1989 ICES/IOC/OSPARCOM polychlorinated biphenyls in marine media intercomparison exercise results of analyses using non-polar and polar columns. Order of congeners in graph A is: PCB 28, PCB 31, PCB 52, PCB 101, PCB 105, PCB 118, PCB 138, PCB 153, PCB 180 and PCB 189. Only PCB 52 was used for graph B. (Dashed line is the ICES-assigned value. Dotted line is $\pm 30\%$ of the ICES-assigned value.) (ng/mL).

6.5. 1990 Exercises

The fifth round of intercomparison exercises for trace organics in sediments and tissues was coordinated by NIST. The exercises materials were ampoules of a gravimetrically-prepared solution of 6 aromatic hydrocarbons, 6 chlorinated pesticides, and 6 PCB congeners in 2,2,4-trimethylpentane VAR3-MIX (QA90S1MX); and an enriched bivalve tissue extract in methylene chloride (QA90E1). The concentrations of the VAR3-MIX solution were adjusted for the purity of the components used and the concentrations confirmed by GC analyses at NIST.

The mussel tissue used in the preparation of QA90E1 was collected by Battelle Ocean Sciences at a number of NS&T Mussel Watch Project sites judged to have relatively low levels of contamination. After aliquots were removed by Battelle for analyses, the remainder of the tissue homogenate was stored frozen and shipped to NIST on dry ice. At NIST, the homogenate was thawed to facilitate removal from the glass containers in which it was stored and then Soxhlet-extracted overnight using dichloromethane. Aliquots of this unenriched tissue extract were analyzed at NIST for the NS&T organic analytes of interest. A gravimetric solution of the

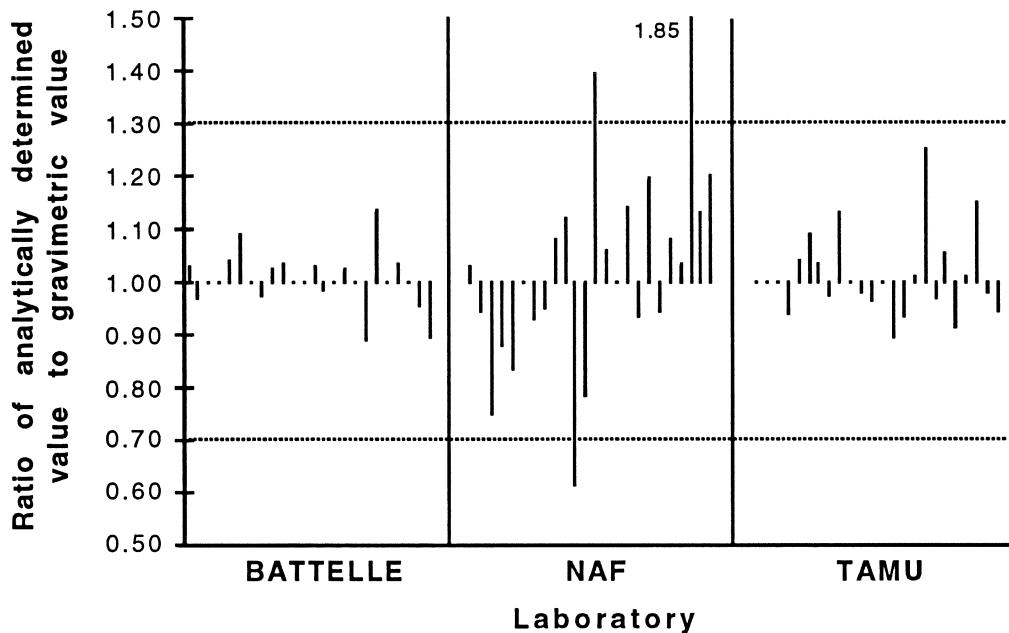


Figure 31. 1989 Gravimetric solution [QA89S1 (VAR2-PAH)] intercomparison exercise ratios of analytically determined mean value of three samples to gravimetric value (Order of analytes same as in Table V.1. Dotted lines are $\pm 30\%$ of gravimetric value.).

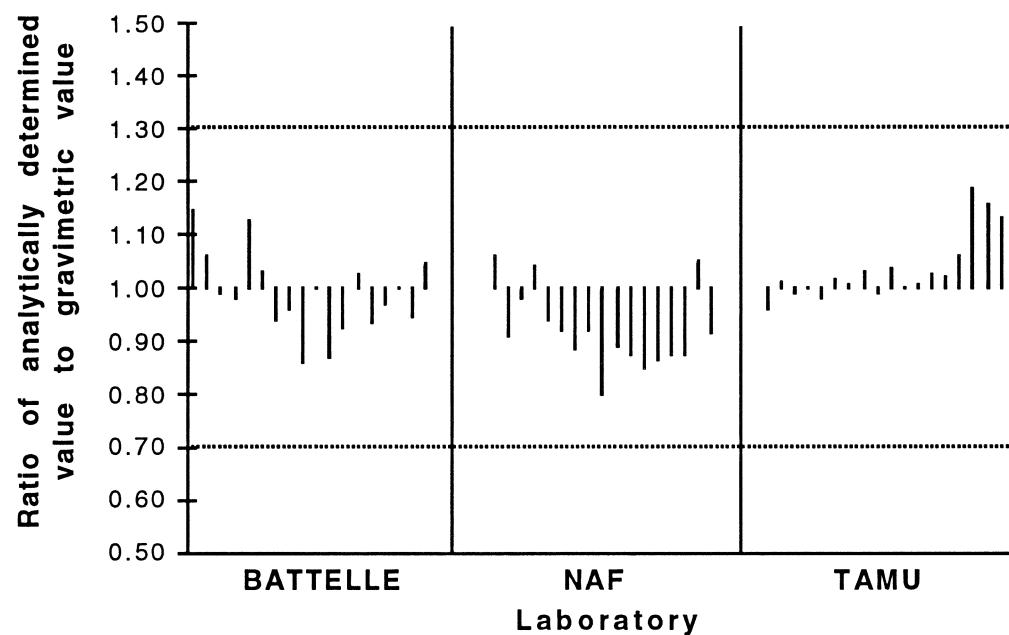


Figure 32. 1989 Gravimetric solution [QA89S1 (VAR2-PCB)] intercomparison exercise ratios of analytically determined mean value of three samples to gravimetric value (Order of analytes same as in Table V.2. Dotted lines are $\pm 30\%$ of gravimetric value.).

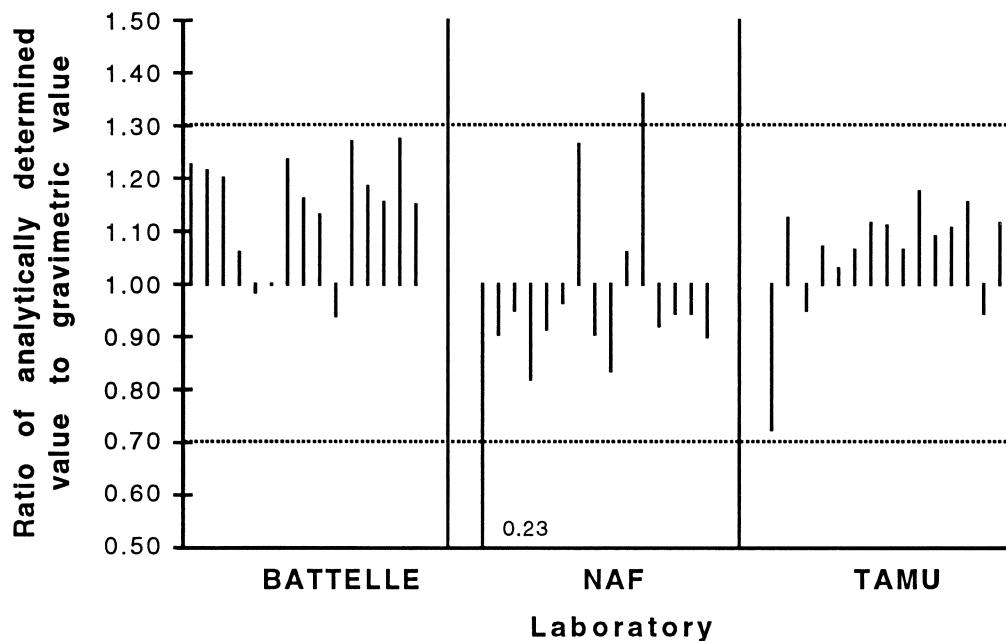


Figure 33. 1989 Gravimetric solution [QA89S1 (VAR2-PES)] intercomparison exercise ratios of analytically determined mean value of three samples to gravimetric value (Order of analytes same as in Table V.3. Dotted lines are $\pm 30\%$ of gravimetric value.).

same 18 analytes as in the VAR3-MIX exercise material was prepared and a weighed aliquot was added to the tissue extract. The amount of enriched extract dispensed into each 5-mL amber ampoule was volumetrically aliquoted (4 mL) and verified by gravimetry before each ampoule was flame sealed. The mean mass of enriched extract in the prepared ampoules was 5.15 g (RSD 0.7%). Each ampoule of QA9OE1 contained the equivalent of the extract of 2.73 g (wet weight) of bivalve tissue plus enrichment solution. The contribution from the unenriched tissue extract to the total concentrations of 12 of the 18 components of interest in the enriched extract was determined to be insignificant and the gravimetric data were used to calculate the NIST "assigned value" for these components. For the 6 additional components, the NIST "assigned value" was determined by summing the contribution to the concentration from the enrichment solution and the concentration present in the unspiked material. Even for these 6, the relative contribution from the unspiked extract was small; i.e., 2% for gamma-HCH, *cis*-chlordane and dieldrin; and 1% for 4,4'-DDE, PCB 101 and PCB 153. Due to solubility concerns, the tissue extract was prepared in dichloromethane. Because evaluation of the accuracy of measuring the mass or volume of an aliquot of a volatile dichloromethane extract was not the objective of the exercise and the amount of material in each ampoule had already been verified at NIST, the participating laboratories were requested to analyze the entire contents of each of three ampoules and to report their results in terms of $\mu\text{g}/\text{ampoule}$ for the PAH components and $\text{ng}/\text{ampoule}$ for the PCB and pesticide components. Therefore, the NIST "assigned values" were computed on this basis. For example, for the PAH components, the values were computed as $\mu\text{g}/5.15 \text{ g}$ of enriched extract, i.e., $\mu\text{g}/\text{ampoule}$ of enriched extract.

After clean-up, the laboratories were asked to analyze one of the extracts in triplicate (i. e., three GC injections), and the other two extracts were analyzed once. Sixteen laboratories reported results for the VAR3-MIX and thirteen laboratories reported results for the tissue

extract. Of the participating laboratories, only three were NS&T contract laboratories. The results are listed in Appendix VI. In 1990, the following were available to the NS&T cooperating laboratories for use as control materials: a sediment collected in Baltimore Harbor, and a composite Boston Harbor mussel tissue material (NIST SRM 1974).

6.5.1. PAHs, PCBs and pesticides in 2,2,4-trimethylpentane solution (VAR3-MIX) (QA90S1MX)

A 2,2,4-trimethylpentane solution was used to test the ability of the laboratories to separate, identify, and quantitate individual compounds. Three ampoules were sent to each laboratory. NIST supplied the gravimetric values but did not participate in the exercises as an independent laboratory. The three NS&T laboratories correctly identified the 18 compounds. The RSDs were well below 10% for most cases.

The results of the PAH analyses are listed in Table VI.1 and shown in Figure 34. The sum of the concentrations of the six PAHs in the gravimetric solution are shown for clarity. The results were within the $\pm 30\%$ envelope although all three laboratories reported results higher than the gravimetric values. The results of the PCB congener analyses are shown in Figure 35. The sum of the concentrations of the six congeners in the gravimetric solution are shown for clarity. The results were similar to those of the PAH analyses, although the values reported by BATTELLE were high. The results of the DDT and metabolite analyses are shown in Figure 36. The sum of the concentrations of 2,4'-DDT and the two metabolites in the gravimetric solution are shown for clarity. The results submitted by BATTELLE were high and just outside the $\pm 30\%$ envelope. The results of the cyclopentadiene pesticide (*cis*-chlordane and Dieldrin) analyses are shown in Figure 37. The sum of the concentrations of these compounds in the exercise solution are shown for clarity. The results were good. No Dieldrin values were submitted by NAF and

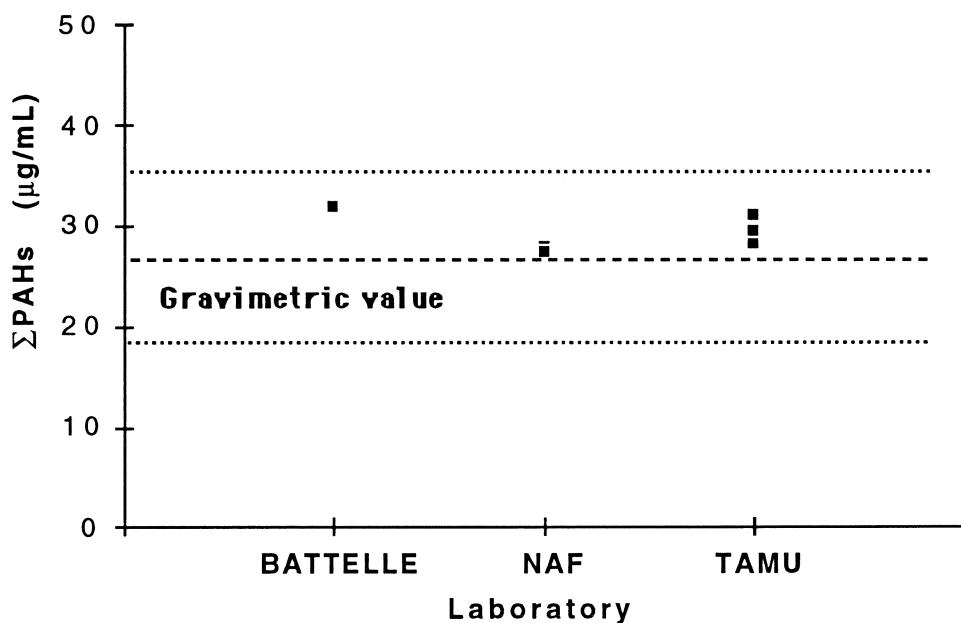


Figure 34. 1990 Gravimetric solution [QA90S1MX (VAR3-MIX)] intercomparison exercise results of polycyclic aromatic hydrocarbon analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) ($\mu\text{g}/\text{ampoule}$).

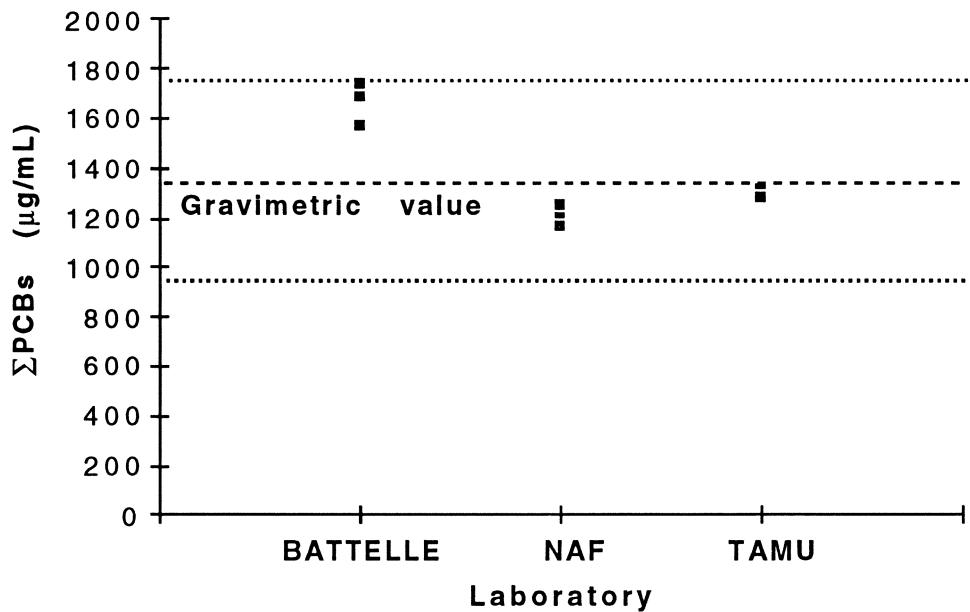


Figure 35. 1990 Gravimetric solution [QA90S1MX (VAR3-MIX)] intercomparison exercise results of polychlorinated biphenyl analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value) (ng/mL).

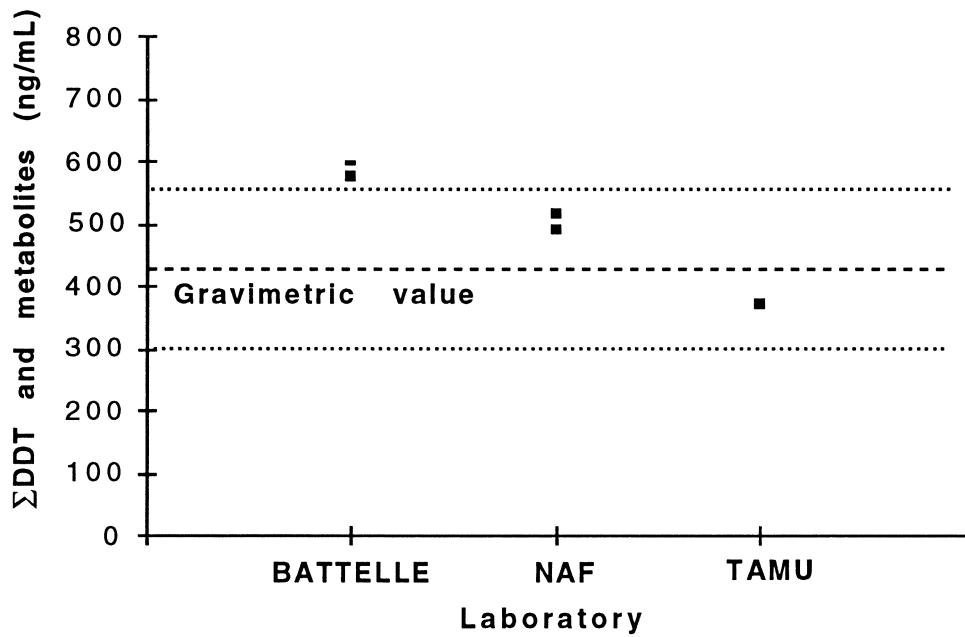


Figure 36. 1990 Gravimetric solution [QA90S1 (VAR3-MIX)] intercomparison exercise results of DDT and metabolites analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

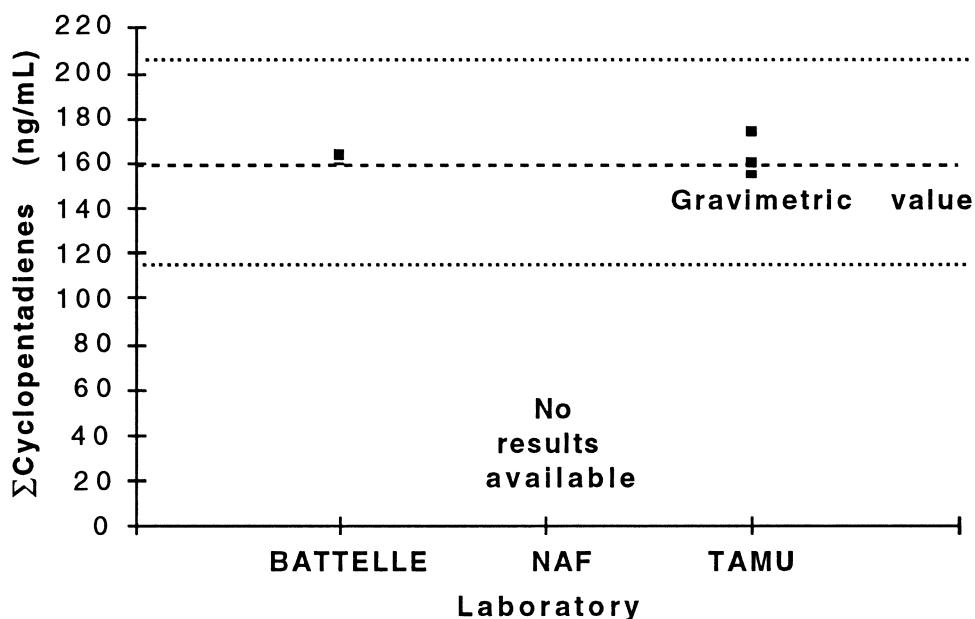


Figure 37. 1990 Gravimetric solution [QA90S1 (VAR3-MIX)] intercomparison exercise results of cyclopentadiene pesticides analyses of three samples (NAF did not report analysis data for Dieldrin.) (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of gravimetric value.) (ng/mL).

the sum of the results of the determinations of the other analytes is not included in the figure. The results of gamma-HCH analyses are shown in Figure 38. The precision was not as good as that shown in the previous figures which show graphic presentations of sums of results, resulting in apparently better precision and accuracy than that of individual compound determinations.

6.5.2. Enriched bivalve tissue extract (QA90E1)

The enriched tissue extract was used to begin the evaluation of the effect of the sample matrix in the analysis process. The concentrations used to spike the tissue extract were much higher in concentration than those of potentially interfering compounds. The enriched tissue extract was sent to the laboratories only after successful completion of the analysis of the mixed 2,2,4-trimethylpentane solution. As with the mixed solution, three ampoules were sent to each laboratory, one of the extracts was analyzed in triplicate and the other two extracts were analyzed once. No TAMU results are available for triplicate analyses of the same ampoule. The three NS&T laboratories correctly identified the 18 compounds. The RSDs were below 10% and well below 5% in many cases.

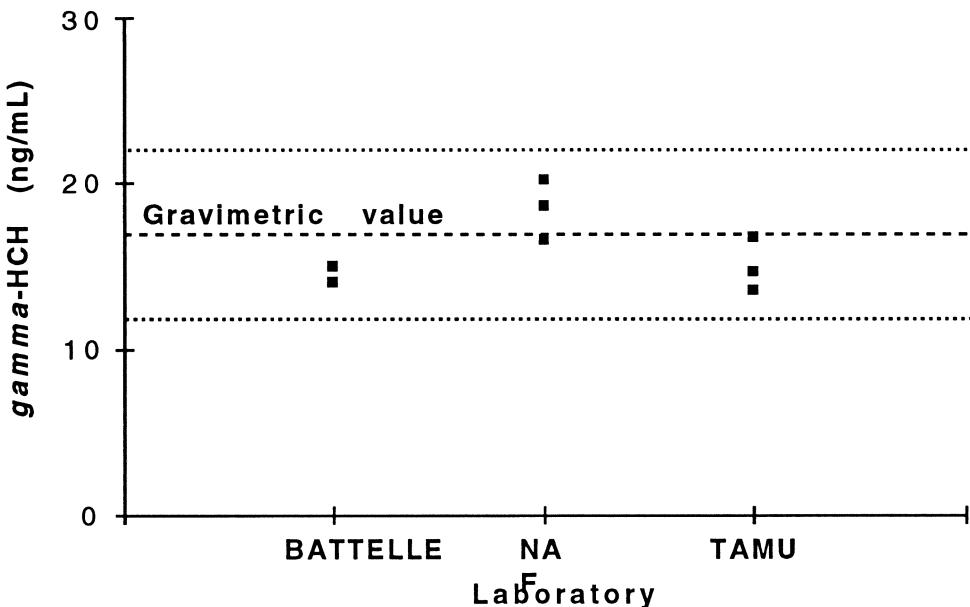


Figure 38. 1990 Gravimetric solution [QA90S1 (VAR3-MIX)] intercomparison exercise results gamma-HCH analyses of three samples (Dashed line is the gravimetric value. Dotted line is $\pm 30\%$ of the gravimetric value.) (ng/mL).

The results of the PAH analyses are listed in Table VI.2 and summarized in Figure 39. The sums of the concentrations of the six PAHs determined were used in the figure for clarity. The results were within the $\pm 30\%$ envelope and the accuracy is good. Similar results were obtained for the PCB analyses (Figure 40). The results of the DDT and metabolite, cyclopentadiene pesticide (*cis*-Chlordane and Dieldrin), and gamma-HCH analyses are shown in Figures 41, 42 and 43. Although the results were within the $\pm 30\%$ envelope, the accuracy and precision were not as good. The results of the gamma-HCH analyses show better precision and accuracy except for those submitted by TAMU.

6.5.3. ICES/IOC/OSPARCOM second step

The second phase of the ICES/IOC/OSPARCOM intercomparison exercise on the analysis of PCB congeners in marine media took place in 1990. TAMU and BATTELLE participated on a voluntary basis as did NIST. The materials used were a solution of chlorobiphenyl congeners, a seal blubber extract and a sediment extract. A complete description of the exercise and results can be found in De Boer *et al.* (1991).

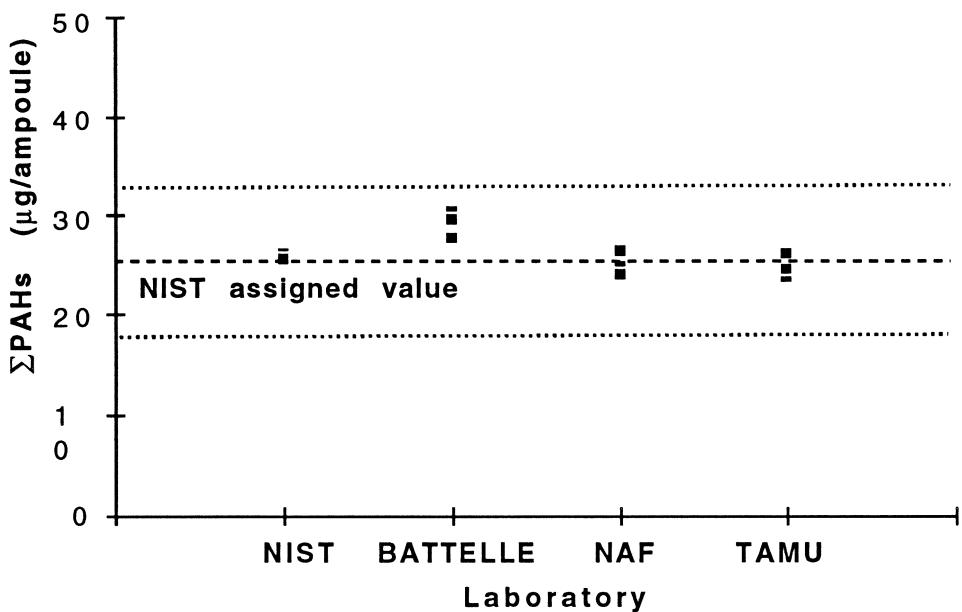


Figure 39. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results of polycyclic aromatic hydrocarbon analyses of three samples (Dashed line is the NIST assigned value. Dotted line is $\pm 30\%$ of the consensus value.) ($\mu\text{g}/\text{ampoule}$).

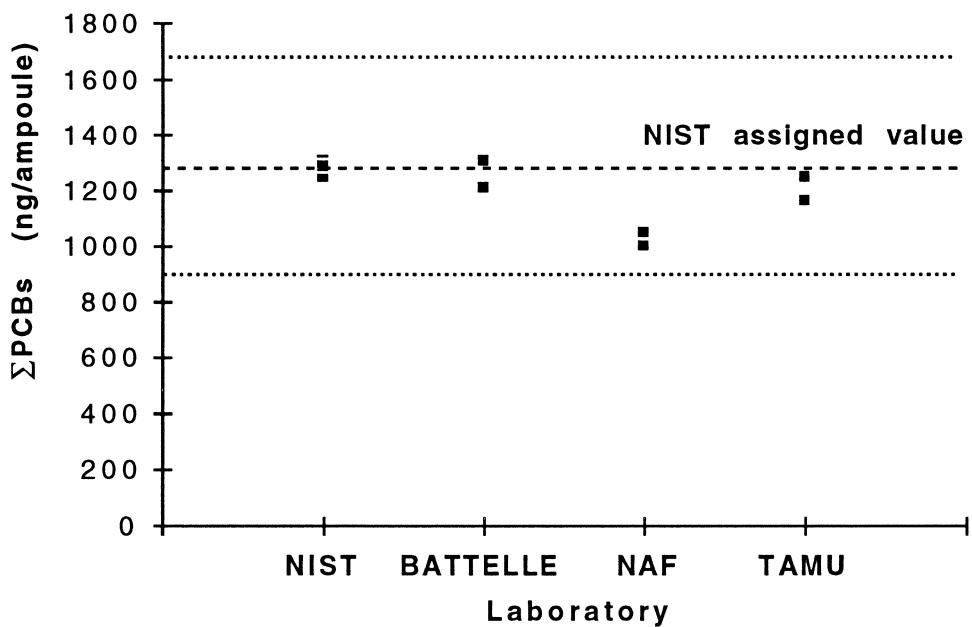


Figure 40. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results of polychlorinated biphenyl analyses of three samples (Dashed line is the NIST assigned value. Dotted line is $\pm 30\%$ of the consensus value.) (ng/ampoule).

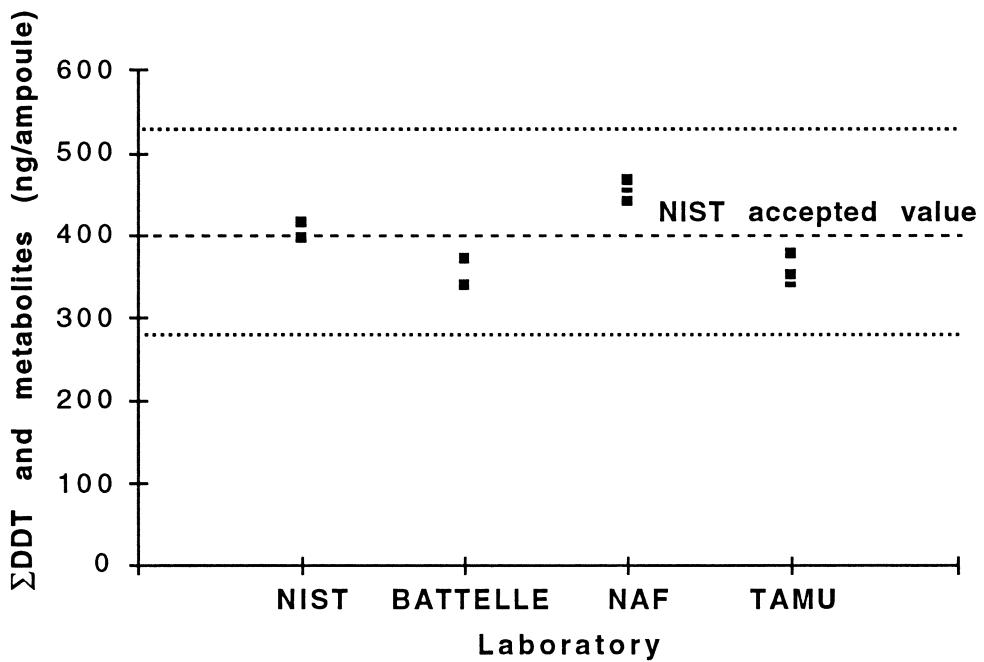


Figure 41. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results of DDT and metabolites analyses of three samples (Dashed line is the consensus value. Dotted line is $\pm 30\%$ of the consensus value.) (ng/ampoule).

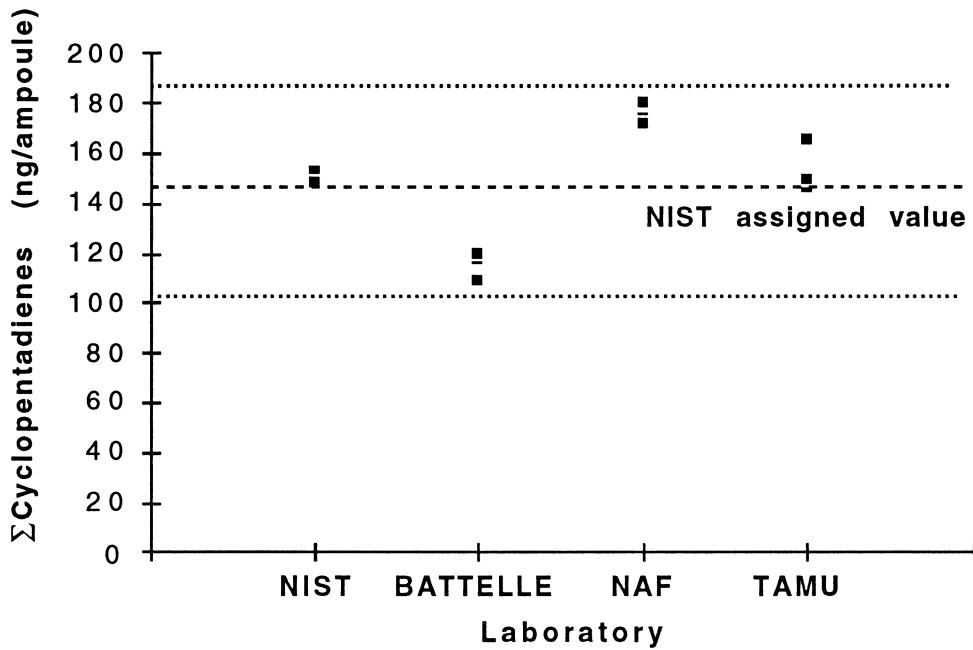


Figure 42. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results of cyclopentadiene pesticide analyses of three samples (Dashed line is the NIST assigned value. Dotted line is $\pm 30\%$ of the consensus value.) (ng/ampoule).

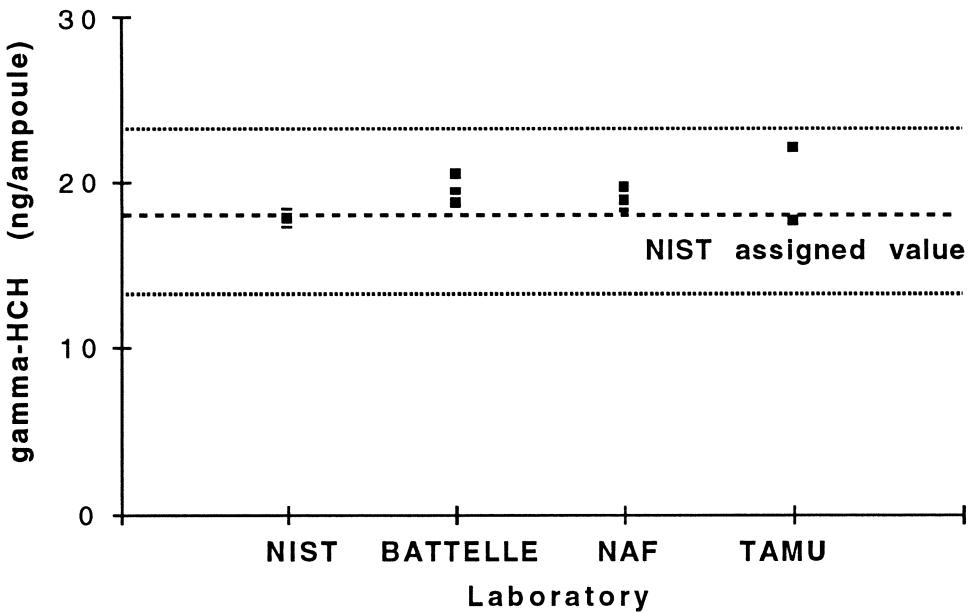


Figure 43. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results of gamma-HCH analyses of three samples (Dashed line is the consensus value. Dotted line is $\pm 30\%$ of the consensus value.) (ng/ampoule).

6.5.4. Comments

The results of the 1990 intercomparison exercises are summarized graphically in Figures 44 and 45. As in Section 6.4.6, the ratio of the analytically determined mean value of three samples to the gravimetric value was calculated for each analyte. The limits of $\pm 30\%$ would result in ratios between 0.7 and 1.3. All the results of NAF and TAMU were within the $\pm 30\%$ limit. The results for benzo[a]pyrene and benzo[e]pyrene for BATTELLE are outside the $\pm 30\%$ limits for both exercise materials. The results of 4,4'-DDE, PCB 28 and PCB 44 in the VAR3-MIX and PCB 195 in the enriched bivalve tissue extract are also outside the $\pm 30\%$ limit for BATTELLE. The BATTELLE PCB results for the VAR3-MIX appear to have a high bias.

Since it is not possible to document the improvement in performance of laboratories participating in the intercomparison exercises due to the large variation in sample matrix and analyte concentration level, evaluation of a non-NS&T laboratory participating in the intercomparison exercise for the first time may give an indication of the level of expertise of the NS&T laboratories at the beginning of the Program compared with current expertise. Anonymity of non-NS&T laboratories participating in the intercomparison exercises is maintained. As seen in Figure 46, the performance of the non-NS&T laboratory just joining the NS&T QA Project was not as good as that of NIST or of an NS&T laboratory.

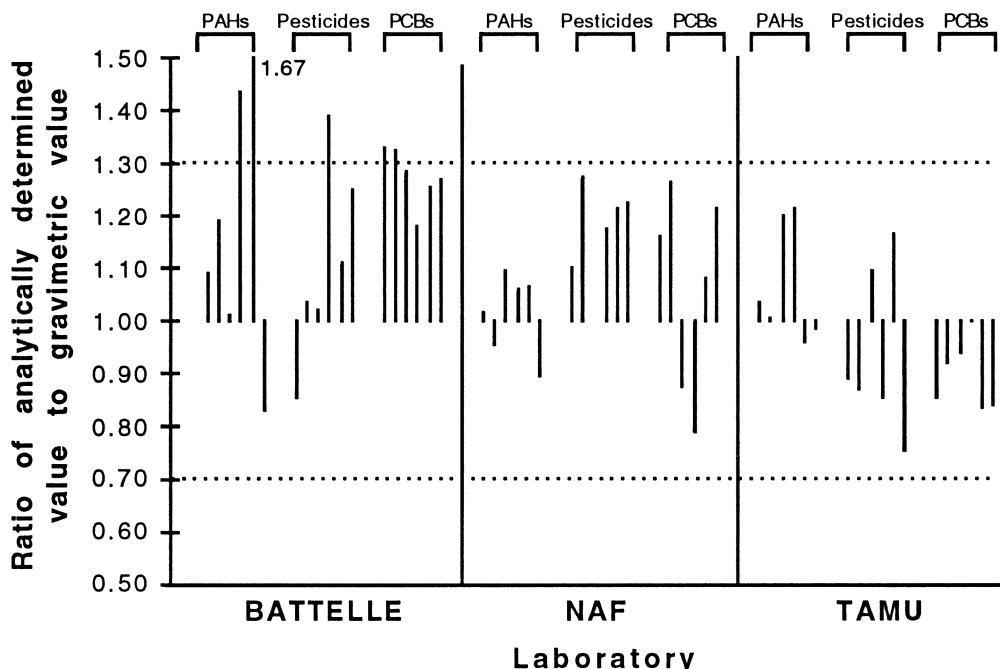


Figure 44. 1990 Gravimetric solution mixture [QA90S1 (VAR3-MIX)] intercomparison exercise ratios of analytically determined mean value of three samples to gravimetric value (Order of analytes same as in Table VI.1 and Figure 38. Dotted lines are $\pm 30\%$ of gravimetric value.).

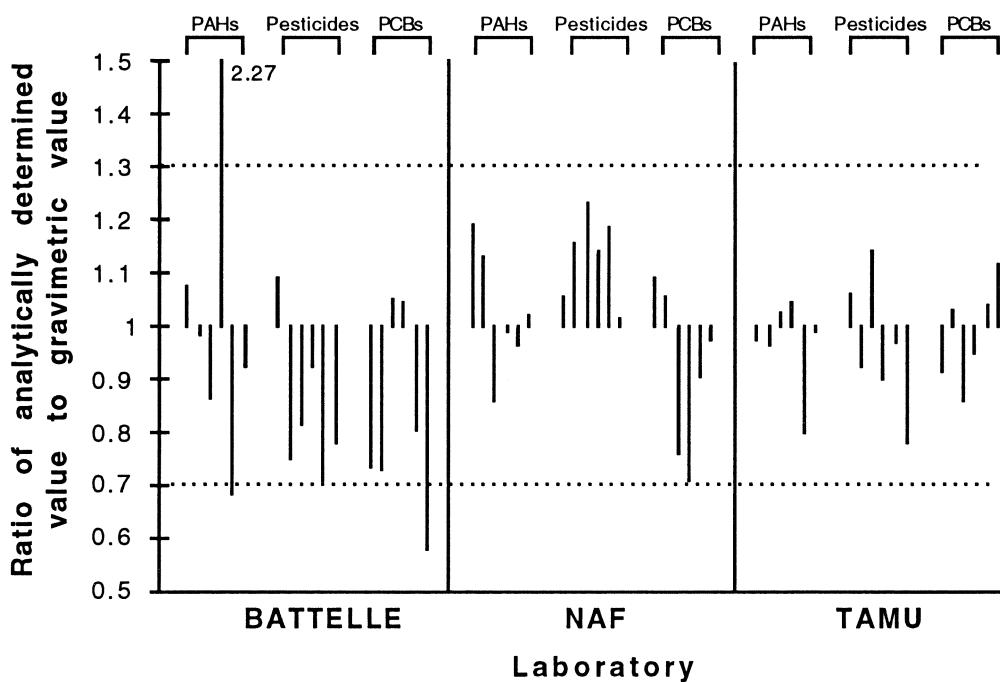


Figure 45. 1990 Enriched bivalve tissue extract [QA90E1] intercomparison exercise ratios of analytically determined mean value of three samples to gravimetric value (Order of analytes same as in Table VI.2 and Figure 38. Dotted lines are $\pm 30\%$ of gravimetric value.).

The inorganic intercomparison exercise results also show that the performance of a laboratory improves measurably within a year or two of beginning participation in the exercises, and that the performance of laboratories that have already achieved an excellent level of performance is normally maintained and documented (S. Berman, National Research Council of Canada, personal communication, 1992).

7. RESULTS AND CONCLUSIONS

The NS&T QA Project is an essential part of the NS&T Program as it assesses data quality, documents the performance of the laboratories and promotes a continued high level of performance. The performance of the NS&T laboratories involved in trace organic analysis has improved since the beginning of the Program. It has been observed that the level of performance of some laboratories participating in the intercomparison exercise for the first time is typically not as good as that of NIST or of an NS&T laboratory but it improves with time.

The QA Project will continue its annual organic and inorganic intercomparison exercises. Participation in the exercises has expanded beyond the NS&T laboratories to include the EPA EMAP laboratories, state and municipal laboratories, and the International Atomic Energy Agency, Marine Environmental Studies Laboratory, Monaco. The response of the U. S. marine chemistry community to the QA Project intercomparison exercises has been very positive and the number of participating laboratories will continue to increase as funds permit.

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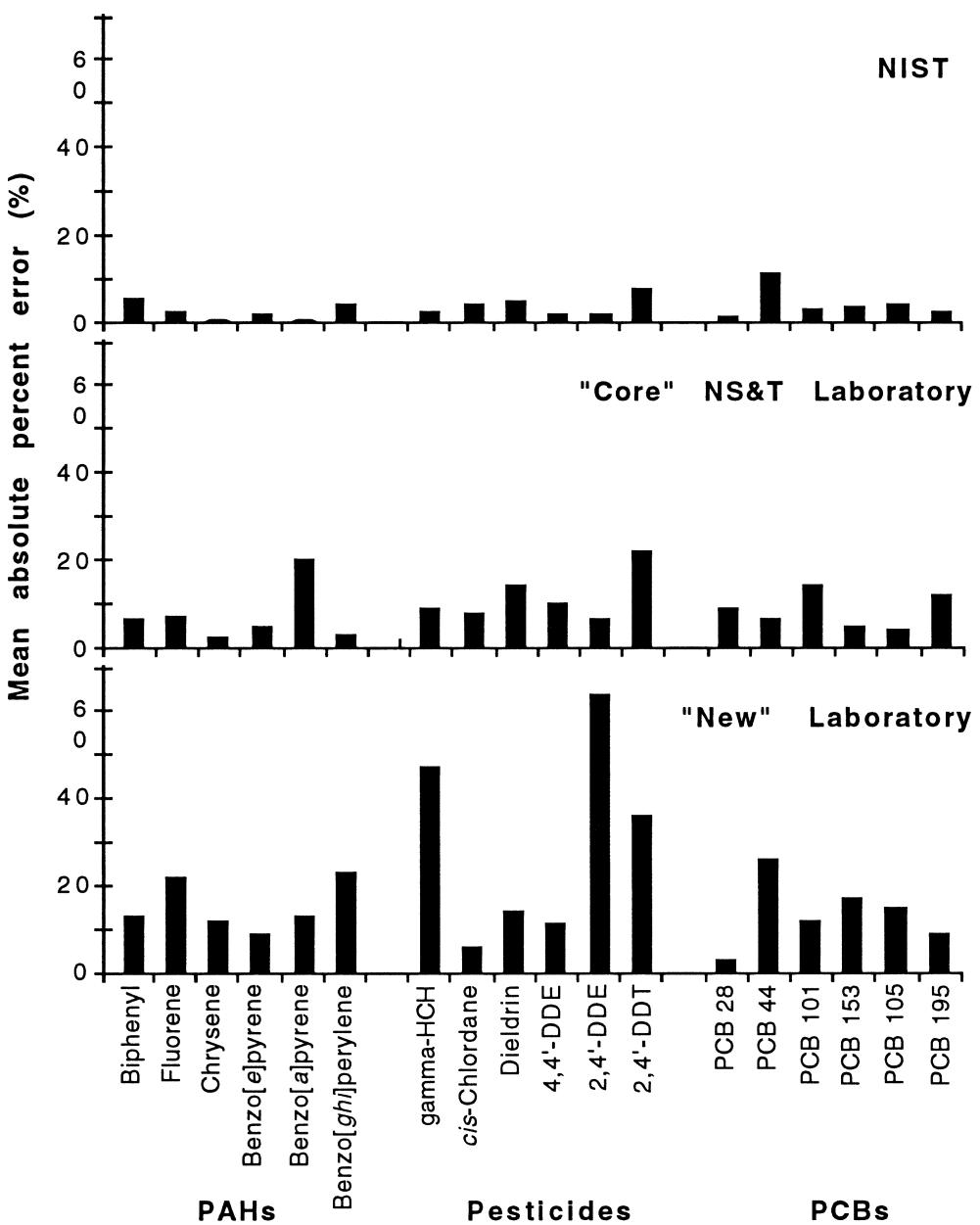


Figure 46. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results mean absolute percent errors of polycyclic aromatic hydrocarbons, pesticides, and polychlorinated biphenyl analyses by NIST, an NS&T laboratory, and a non-NS&T laboratory participating in the intercomparison exercises for the first time.

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9. ACKNOWLEDGEMENTS

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APPENDIX I

**NIST STANDARD REFERENCE MATERIALS
PARTIALLY FUNDED BY THE NS&T PROGRAMS**

I.1. NIST SRM 1491, Aromatic Hydrocarbons in Hexane/Toluene

This SRM is a solution of 24 aromatic hydrocarbons (AHs) in a hexane/toluene solvent blend containing 96% hexane by weight (Table I.1). Certified concentrations, which range from 5 to 8 µg/mL, are provided for 23 of these AHs, and a noncertified concentration is provided for 2-methylnaphthalene. This SRM is intended primarily for use in the calibration of chromatographic instrumentation used for the determination of the certified compounds. Development of this SRM was funded by the NOAA NS&T Program.

The 24 aromatic hydrocarbons used in the preparation of this SRM were obtained from the Community Bureau of Reference (BCR), Brussels, Belgium or commercial sources. The AH solution was prepared by weighing the individual AH components and toluene and mixing until completely dissolved. Hexane was added to this solution and thoroughly mixed. The total mass of the solution was measured and the concentrations calculated. These gravimetric concentrations were adjusted for the consensus purity estimation of each component. Capillary gas chromatography with flame ionization detection was used for the confirmation analysis. The bulk solution was then chilled to approximately -5°C and 1.2-mL aliquots were dispensed into 2-mL amber ampoules which were then flame sealed. Complete preparation and analysis information can be found in the Certificate of Analysis (NIST, 1989a).

I.2. NIST SRM 1492, Chlorinated Pesticides in Hexane

This SRM is a solution of 15 chlorinated pesticides in hexane at nominal concentrations of 200 ng/mL. It is intended primarily for use in the calibration of chromatographic instrumentation used for the determination of the certified compounds. Development of this SRM was funded by the NOAA NS&T Program.

Pesticides used in the preparation of this SRM were obtained from the U.S. EPA Pesticides & Industrial Chemicals Repository, Research Triangle Park, NC and the Office of Reference Materials, Office of the Government Chemist (formerly National Physical Laboratory), United Kingdom. The pesticides include DDT and metabolites, cyclopentadiene compounds, gamma-HCH (Lindane), Mirex, and hexachlorobenzene (Table I.2).

Table I.1. Components of NIST SRM 1491, Aromatic Hydrocarbons in Hexane/Toluene.

1-Methylnaphthalene	Benzo[<i>k</i>]fluoranthene
2-Methylnaphthalene	Benz[<i>a</i>]anthracene
1-Methylphenanthrene	Biphenyl
1,6,7-Trimethylnaphthalene	Chrysene
2,6-Dimethylnaphthalene	Dibenz[<i>a,h</i>]anthracene
Acenaphthene	Fluoranthene
Acenaphthylene	Fluorene
Anthracene	Indeno[1,2,3- <i>cd</i>]pyrene
Benzo[<i>a</i>]pyrene	Naphthalene
Benzo[<i>b</i>]fluoranthene	Perylene
Benzo[<i>e</i>]pyrene	Phenanthrene
Benzo[<i>ghi</i>]perylene	Pyrene

Table I.2. Components of NIST SRM 1492, Chlorinated Pesticides in Hexane.

2,4'-DDD	Dieldrin
2,4'-DDE	gamma-HCH
2,4'-DDT	Heptachlor
4,4'-DDD	Heptachlor epoxide
4,4'-DDE	Hexachlorobenzene
4,4'-DDT	Mirex
Aldrin	<i>trans</i> -Nonachlor
<i>cis</i> -Chlordane	

The pesticide solution was prepared by weighing and mixing the individual pesticides and hexane. The weighed components were added to the hexane and mixed until completely dissolved and homogenized. The total mass of this solution was measured and the concentrations calculated. The gravimetric concentrations were adjusted for the consensus purity estimation of each component. The bulk solution was then chilled to approximately -5°C and aliquots were dispensed into amber glass ampoules, which were then flame sealed. Capillary gas chromatography with electron capture detection used for the confirmation analysis. Complete preparation and analysis information can be found in the Certificate of Analysis (NIST, 1989b).

I.3. NIST SRM 1493, Chlorinated Biphenyl Congeners in 2,2,4-Trimethylpentane (Nominal Concentration 200 ng/mL)

This SRM is a solution of the 20 PCB congeners in the NS&T list of analytes and is currently under final preparation. This SRM is intended primarily for use in the calibration of chromatographic instrumentation used for the determination of the certified compounds. Development of this SRM was partially funded by the NOAA NS&T Program.

I.4. NIST SRM 1941, Organics in Marine Sediment

SRM 1941 is intended for use in validating analytical methods for the determination of trace levels of selected PAHs and sulfur in marine sediments. Development of this SRM was funded by the NOAA NS&T Program.

The marine sediment used to prepare this SRM was collected in the Chesapeake Bay at the mouth of Baltimore Harbor in Maryland, near the Francis Scott Key Bridge (39° 12.85' N and 76° 31.70' W). The sediment was air dried, pulverized, sieved ($\leq 150 \mu\text{m}$), homogenized in a cone blender, and subsampled into amber glass bottles with Teflon-lined screw caps. The material was radiation-sterilized at an estimated minimum dose of 3.2 megarads.

Certified concentration values are available for 11 PAHs naturally present in the sediment and noncertified concentrations for other analytes (Table I.3). The noncertified concentrations for additional PAHs, PCBs, pesticides, and trace elements are provided for information only. Complete preparation and analysis information can be found in the Certificate of Analysis (NIST, 1990a) and in Schantz *et al.* (1990).

Table I.3. Components of NIST SRM 1941, Organics in Marine Sediment.

Certified values			
Anthracene		Fluoranthene	
Benzo[a]pyrene		Indeno[1,2,3- <i>cd</i>]pyrene	
Benzo[b]fluoranthene		Perylene	
Benzo[ghi]perylene		Phenanthrene	
Benzo[k]fluoranthene		Pyrene	
Benz[a]anthracene			
Noncertified values			
PAHs			
1,3-, 2,10-, 3,9-, and 3,10-Dimethylphenanthrene		Chrysene	
1,6- and 2,9-Dimethylphenanthrene		Fluorene	
1,7-Dimethylphenanthrene		Naphthalene	
1-Methylnaphthalene		Triphenylene	
1-Methylphenanthrene			
2,3-Dimethylphenanthrene			
2,6-Dimethylnaphthalene			
2,6-Dimethylphenanthrene			
2,7-Dimethylphenanthrene			
2-Methylnaphthalene			
2-Methylphenanthrene			
3-Methylphenanthrene			
9-Methyl- and 4-Methylphenanthrene		4,4'-DDD	
Acenaphthene		4,4'-DDE	
Acenaphthylene		4,4'-DDT	
Benzo[a]fluoranthene		cis-Chlordane	
Benzo[e]pyrene		Dieldrin	
Benzo[j]fluoranthene		Heptachlor epoxide	
Biphenyl		trans-Nonachlor	
PCBs			
		PCB 18/15, PCB 28, PCB 52, PCB 66/95, PCB 101/90, PCB 105, PCB 118, PCB 138/163/164, PCB 153, PCB 170/190, PCB 180, PCB 187/159/182, PCB 195/208, PCB 206, PCB 209	
Chlorinated Pesticides			
		4,4'-DDD	
		4,4'-DDE	
		4,4'-DDT	
		cis-Chlordane	
		Dieldrin	
		Heptachlor epoxide	
		trans-Nonachlor	
Elements			
B	V	Rb	Eu
Na	Cr	Ag	Tb
Al	Mn	Cd	Gd
Si	Fe	Sb	Hf
Cl	Co	Cs	Ta
K	Zn	La	Th
Sc	As	Ce	U
Ti	Se	Sm	

Table I.4. Components of NIST SRM 1974, Organics in Mussel Tissue (*Mytilus edulis*).

Certified values			
PAHs		PCBs	
Chlorinated Pesticides			
Elements			
Anthracene		Indeno[1,2,3- <i>cd</i>]pyrene	
Benzo[a]pyrene		Perylene	
Benzo[b]fluoranthene		Phenanthrene	
Benzo[ghi]perylene		Pyrene	
Fluoranthene			
Noncertified values			
1,3-, 2,10-, 3,9-, and 3,10-Dimethylphenanthrene		PCB 18, PCB 28, PCB 44, PCB 52, PCB 66, PCB 101/90, PCB 105, PCB 118, PCB 128, PCB 138/163/164, PCB 153, PCB 180, PCB 187/182	
1,6- and 2,9-Dimethylphenanthrene			
1,7-Dimethylphenanthrene			
2,6-Dimethylphenanthrene			
2,7-Dimethylphenanthrene			
2- and 9-Ethylphenanthrene and 3,6-Dimethylphenanthrene			
2-Methylnaphthalene		2,4'-DDD	
9- and 4-Methylphenanthrene		2,4'-DDE	
Benzo[a]fluoranthene		2,4'-DDT	
Benzo[e]pyrene		4,4'-DDD	
Benzo[j]fluoranthene/benzo[k]fluoranthene		4,4'-DDE	
Benzo[k]fluoranthene		4,4'-DDT	
Benz[a]anthracene		cis-Chlordane	
Chrysene/Triphenylene		Dieldrin	
Dibenz[a,h]anthracene		trans-Nonachlor	
Fluorene			
Indeno[1,2,3- <i>cd</i>]fluoranthene			
1-Methylnaphthalene			
1-Methylphenanthrene			
Na	Co	Sr	Eu
Mg	Fe	Mo	Hf
Al	Ni	Ag	Ta
Cl	Cu	Cd	Au
K	Zn	Sb	Hg
Sc	As	Cs	Pb
V	Se	La	Th
Cr	Br	Ce	
Mn	Rb	Sm	

I.5. NIST SRM 1974, Organics in Mussel Tissue (*Mytilus edulis*)

NIST SRM 1974 is intended primarily for use in validating analytical methods for the determination of selected PAHs in marine bivalve tissue or materials of similar matrix. Analytes are listed in Table I.4. Development of this SRM was funded by the NOAA NS&T Program. Complete preparation and analysis information can be found in the Certificate of Analysis (NIST, 1990b) and in Wise *et al.* (1991).

The mussels (*Mytilus edulis*) used for the preparation of this SRM were collected on December 1, 1987 from Dorchester Bay within Boston Harbor, MA (42° 18.25' N, 71° 02.31' W). Approximately 2400 individual mussels were collected by hand at low tide. The samples were transported to the Battelle New England Laboratory (Duxbury, MA) where the mussels were rinsed in a tank supplied with pumped sea water. Rocks and other debris were removed. The samples were placed in insulated, Teflon-lined wooden containers, frozen and transported to NIST on dry ice. The samples were transferred to Teflon bags and stored in a liquid nitrogen vapor freezer (-120°C) until shucked. The mussel tissue was removed from the shell using the following procedure. The mussels were allowed to warm up to about 0°C. The tissue was removed from the shell using a titanium knife, placed in Teflon bags, and immediately returned to a liquid nitrogen freezer. The frozen mussel tissue was pulverized using a cryogenic procedure. After mixing, the mussel tissue homogenate was aliquoted into pre-cooled glass bottles. The bottles of SRM 1974 have been stored at -80°C since preparation.

I.6. NIST SRM 2260, Aromatic Hydrocarbons in Toluene (Nominal Concentration 60 µg/mL)

This SRM is a solution of 24 aromatic hydrocarbons (AHs) in toluene (Table I.5). Certified concentrations are provided for 23 of these AHs. A noncertified concentration is provided for 2-methylnaphthalene. This SRM is intended primarily for use in the calibration of chromatographic instruments used for the determination of the certified compounds. These values are based on results obtained from the gravimetric preparation of this solution and from the analytical results determined by using gas chromatography. Partial support for the preparation and certification of this SRM was provided by the NOAA NS&T Program.

All chemicals used in the preparation of this SRM were obtained from commercial sources or the Community Bureau of Reference (BCR), Brussels, Belgium. The AH solution was prepared by weighing the individual AH components and toluene, and mixing until completely dissolved and homogenized. This bulk solution was then chilled to approximately -5 °C and 1.2-mL aliquots were dispensed into 2-mL amber ampoules that were then flame sealed. Complete preparation and analysis information can be found in the Certificate of Analysis (NIST, 1991).

I.7. NIST SRM 2261, Chlorinated Pesticides in Hexane (Nominal Concentration 2 µg/mL)

This SRM is a solution of 15 chlorinated pesticides in hexane (Table I.6). This SRM is intended primarily for use in the calibration of chromatographic instrumentation used for the determination of the certified compounds. Development of this SRM was partially funded by the NOAA NS&T Program. Complete preparation and analysis information can be found in the Certificate of Analysis (NIST, 1992).

Table I.5. Components of NIST SRM 2260, Aromatic Hydrocarbons in Toluene (Nominal Concentration 60 µg/mL).

Certified values

1,6,7-Trimethylnaphthalene	Chrysene
2,6-Dimethylnaphthalene	Dibenz[<i>a,h</i>]anthracene
Acenaphthene	Fluoranthene
Acenaphthylene	Fluorene
Anthracene	Indeno[1,2,3- <i>cd</i>]pyrene
Benzo[<i>a</i>]pyrene	1-Methylnaphthalene
Benzo[<i>b</i>]fluoranthene	1-Methylphenanthrene
Benzo[<i>e</i>]pyrene	Naphthalene
Benzo[<i>ghi</i>]perylene	Perylene
Benzo[<i>k</i>]fluoranthene	Phenanthrene
Benz[<i>a</i>]anthracene	Pyrene
Biphenyl	

Table I.6. Components of NIST SRM 2261, Chlorinated Pesticides in Hexane (Nominal Concentration 2 µg/mL).

2,4'-DDD	Dieldrin
2,4'-DDE	gamma-HCH
2,4'-DDT	Heptachlor
4,4'-DDD	Heptachlor epoxide
4,4'-DDE	Hexachlorobenzene
4,4'-DDT	Mirex
Aldrin	<i>trans</i> -Nonachlor
<i>cis</i> -Chlordane	

Pesticides used in the preparation of this SRM were donated by the US EPA Pesticides & Industrial Chemicals Repository, and the Office of Reference Materials, Laboratory of the Government Chemist, U.K. The pesticide solution was prepared at NIST by weighing and mixing the individual pesticides with hexane. The total mass of this solution was then measured. The calculated concentrations were adjusted for the individual consensus purity estimates of each component. The consensus purity estimations of the components were based on NIST analyses using capillary gas chromatography with flame ionization detection, the purity assay information from the component suppliers and, where appropriate, differential scanning calorimetry. This bulk solution was then chilled to approximately -5 °C, dispensed into 2-mL amber glass ampoules, and flame sealed.

Table I.7. Components of SRM 2262, Chlorinated Biphenyl Congeners in 2,2,4-Trimethylpentane (Nominal Concentration 2 µg/mL).

PCB 1	PCB 50	PCB 118	PCB 187
PCB 3	PCB 52	PCB 126	PCB 188
PCB 8	PCB 66	PCB 128	PCB 195
PCB 15	PCB 77	PCB 138	PCB 201 *
PCB 18	PCB 87	PCB 153	PCB 206
PCB 28	PCB 101	PCB 154	PCB 209
PCB 29	PCB 104	PCB 170	
PCB 44	PCB 105	PCB 180	

* PCB 200 in Ballschmiter and Zell (1980) numbering scheme.

I.8. NIST SRM 2262, Chlorinated Biphenyl Congeners in 2,2,4-Trimethylpentane (Nominal Concentration 2 µg/mL)

This SRM is a solution of 28 PCB congeners currently under final preparation (Table I.7). This SRM is intended primarily for use in the calibration of chromatographic instrumentation used for the determination of the certified compounds. Development of this SRM was partially funded by the NOAA NS&T Program.

APPENDIX II

1986 TRACE ORGANIC INTERCOMPARISON EXERCISE MATERIALS AND RESULTS

NIST:	National Institute of Standards and Technology
BATTELLE:	Battelle Ocean Sciences
NAF:	NOAA/NMFS/Northwest Fisheries Science Center
NEFSC:	NOAA/NMFS/Northeast Fisheries Science Center
SAIC	Science Applications International Corporation
SEFSC:	NOAA/NMFS/Southeast Fisheries Science Center
TAMU:	Texas A&M University

Table II.1. 1986 Polycyclic aromatic hydrocarbons in DUWAMISH III sediment intercomparison exercise mean (n=3) results (ng/g dry weight).

Compound	NAF	RSD*	Laboratory						RSD	TAMU	RSD
			NEFSC	RSD	SEFSC	RSD	BATTELLE	RSD			
1-Methylnaphthalene	120	16	80	16	150	8	130	9	88	6	120
1-Methylphenanthrene	220	11	410	52	320	10	330	22	300	14	300
2,6-Dimethylnaphthalene	70	10	58	15	76	4	96	22	63	8	72
2-Methylnaphthalene	160	17	110	19	180	6	210	12	140	5	170
Acenaphthene	300	22	290	16	420	9	390	12	330	3	320
Anthracene	510	3	650	16	730	2	850	5	600	11	590
Benzo[a]pyrene	1800	3	1700	7	2700	6	2400	19	1800	6	1900
Benzo[e]pyrene	1600	4	1400	5	2000	9	2300	18	1900	9	1400
Benz[a]anthracene	1500	7	1400	5	2100	10	2000	14	1500	10	2100
Biphenyl	39	13	31	8	57	7	48	11	33	5	42
Chrysene	2600	7	2100	7	3600	6	3500	14	2500	10	3000
Dibenz[a,h]anthracene	310	4	310	5	430	7	460	19	430	6	220
Fluoranthene	3900	9	3700	4	5600	7	5200	19	4200	11	4600
Fluorene	310	3	280	18	430	10	460	10	340	2	320
Naphthalene	320	11	250	21	330	11	400	17	310	6	370
Perylene	510	2	460	8	710	5	850	18	580	8	490
Phenanthrene	2300	8	2200	9	3200	6	3200	16	2500	8	2400
Pyrene	4100	5	3900	5	5800	6	6600	23	4800	13	5500

* Relative standard deviation expressed as a percent of the mean of the triplicate analysis.

Table II.2. 1986 Polychlorinated biphenyls in DUWAMISH III sediment intercomparison exercise mean (n=3) results (ng/g dry weight).

Compound	Laboratory											
	NAF	RSD*	NEFSC	RSD	SEFSC	RSD	BATTELLE	RSD	SAIC	RSD	TAMU	RSD
Dichlorobiphenyls	< 1		13	37	< 8	4	21	Δ 2		4	18	
Trichlorobiphenyls	49	8	54	11	83	39	55	24	59	7	65	9
Tetrachlorobiphenyls	190	8	220	11	270	8	130	17	230	16	290	16
Pentachlorobiphenyls	470	20	440	23	390	11	510	6	370	20	450	17
Hexachlorobiphenyls	410	18	330	12	350	7	420	5	480	16	410	20
Heptachlorobiphenyls	130	16	120	31	200	8	160	8	200	11	110	20
Octachlorobiphenyls	52	11	38	32	58	74	21	50	22	34	18	
Nonachlorobiphenyls	10	52	17	48	8	11	18	2	9	47	5	11
PCB 8	< 1	< 3		< 8		NR		Δ 2	0	0.8	76	
PCB 31	23	7	23	10	32	19	NR		36	8	28	6
PCB 47	8	13	9	7	14	11	17	28	11	18	9	5
PCB 101	70	20	64	14	63	3	74	10	72	18	74	14
PCB153	110	20	77	10	72	4	140	8	120	15	72	20
PCB 185	< 0.4	5	30	< 2		NR		NR		4	22	
PCB 194	8	27	17	51	9	10	23	26	15	27	10	25
PCB 206	27	52	17	48	7	11	18	45	9	47	4	19

* Relative standard deviation expressed as a percent of the mean of the triplicate analysis; NR - not reported; Δ n=2.

Table II.3. 1986 Pesticides in DUWAMISH III sediment intercomparison exercise mean ($n=3$) results (ng/g dry weight).

Compound	Laboratory									
	NAF	RSD*	NEFSC	RSD	SEFSC	RSD BATTELLE	RSD	SAIC	RSD	TAMU
2,4'-DDD	4	2	8	39	7	6	NR	15	33	8
2,4'-DDE	< 0.4	< 1	< 3	< 3	< 2	< 2	NR	NR	NR	36
2,4'-DDT	4	16	5	35	21	10	68	8	2.5	6
4,4'-DDD	15	7	27	92	21	10	68	31	2.3	23
4,4'-DDE	7	11	10	37	9	6	33	12	5.0	8
4,4'-DDT	< 0.5	10	8.3	< 2	< 2	29	16	NR	10	39
Aldrin	< 0.3	< 0.6	< 2	< 2	< 2	NR	NR	NR	NR	NR
cis-Chlordane	0.9	3	2	11	2	3	NR	3	14	1
Dieldrin	< 0.3	< 0.7	< 2	< 2	< 2	NR	NR	NR	NR	3
gamma-HCH	< 0.2	< 0.6	< 1	< 1	< 1	NR	NR	1	2.0	0.08
Heptachlor	< 0.4	< 0.7	< 2	< 2	< 2	NR	NR	NR	NR	50
Heptachlor epoxide	< 0.3	< 0.8	< 2	< 2	< 2	NR	NR	0.9	11	0.7
Hexachlorobenzene	0.4	36	1	14	< 1	0.6	3.3	Δ 0.5	1	67
Mirex	< 0.4	< 0.8	< 2	< 2	< 2	NR	NR	NR	0.8	74
trans-Nonachlor	0.4	1	0.9	17	< 1	Δ 0.9	1	18	1	22
										18

* Relative standard deviation expressed as a percent of the mean of the triplicate analysis; NR - not reported; Δ n=2.

Table II.4. 1986 Polycyclic aromatic hydrocarbons in DUWAMISH III sediment intercomparison exercise mean ($n=3$) results reported by NIST using gas chromatography with flame ionization detection and liquid chromatography with fluorescence detector (ng/g dry weight).

Compound	GC	RSD*	LC	RSD
1-Methylnaphthalene	NR		NR	
1-Methylphenanthrene	NR		NR	
2,6-Dimethylnaphthalene	NR		NR	
2-Methylnaphthalene	NR		NR	
Acenaphthene	NR		NR	
Anthracene	710	8	490	8
Benz[a]pyrene	2500	7	2100	7
Benz[e]pyrene	1900	5	NR	
Benz[a]anthracene	1800	11	1400	8
Biphenyl	NR		NR	
Chrysene	NR		1900	6
Dibenz[a,h]anthracene	NR		NR	
Fluoranthene	3700	12	3400	6
Fluorene	NR		NR	
Naphthalene	NR		NR	
Perylene	770	5	570	5
Phenanthrene	2400	9	2300	7
Pyrene	3900	9	3600	7

* Relative standard deviation expressed as a percent of the mean of the triplicate analysis; NR - not reported.

Table II.5. 1986 Polycyclic aromatic hydrocarbons in MUssel II tissue intercomparison exercise mean (n=3) results (ng/g dry weight).

Compound	NAF	RSD*	NEFSC	RSD	SEFSC	RSD	BATTELLE			RSD	TAMU
							Laboratory	SAIC	RSD		
1-Methylnaphthalene	6200	3	5800	3	7100	4	5300	12	5200	1	7000
1-Methylphenanthrene	170	38	350	17	1000	35	460	37	330	23	290
2,6-Dimethylnaphthalene	2500	6	2700	6	3200	4	2700	18	3200	5	3300
2-Methylnaphthalene	7200	3	7700	3	8300	4	6300	12	6200	1	7200
Acenaphthene	Δ 130	5	1300	7	790	11	230	19	340	7	330
Anthracene	160	14	150	19	200	36	270	61	170	28	180
Benz[a]pyrene	74	9	110	9	280	11	NR	120	17	100	24
Benzo[e]pyrene	180	8	180	11	Δ 160	4	170	24	◊ 90	170	24
Benz[a]anthracene	190	8	1100	31	250	9	210	23	140	23	260
Biphenyl	1300	8	1500	5	1600	4	1300	5	1400	8	1500
Chrysene	420	10	340	11	400	3	◊ 620	280	20	350	21
Dibenz[a,h]anthracene	31	26	25	45	90	50	NR	NR	NR	84	71
Fluoranthene	860	19	820	13	860	12	930	12	980	19	820
Fluorene	900	2	940	4	1200	13	1200	6	1300	9	1000
Naphthalene	2000	5	1900	1	2000	3	1800	12	1500	4	2000
Perylene	130	9	56	4	Δ 200	103	NR	NR	NR	100	38
Phenanthrene	1200	16	1200	9	1500	4	1300	3	1500	14	1300
Pyrene	430	18	430	12	Δ 560	1	870	32	530	47	480

* Relative standard deviation expressed as a percent of the mean of the triplicate analysis; NR - not reported; Δ n=2; ◊ n=1.

Table II.6. 1986 Polychlorinated biphenyls in MUSSEL II tissue intercomparison exercise mean (n=3) results (ng/g dry weight).

Compound	NAF	RSD*	NEFSC	RSD	SEFSC	RSD BATTELLE	RSD	SAIC	RSD	TAMU	RSD	Laboratory	
												NR	NR
Dichlorobiphenyls	24	4	10	14	◊ 10	NR	NR	NR	NR	NR	NR	24	20
Trichlorobiphenyls	4.9	5	3.4	2.5	1.9	3.7	NR	NR	NR	NR	NR	500	15
Tetrachlorobiphenyls	190	11	420	2.8	420	1.1	130	2.2	190	5	500	6	6
Pentachlorobiphenyls	660	9	670	2.2	550	7	450	1.8	600	4	920	4	14
Hexachlorobiphenyls	270	6	430	2.0	330	1.7	280	2.0	420	4	530	5	21
Heptachlorobiphenyls	6.3	12	73	2.4	NR	5.5	8	5.7	5	NR	NR	1.6	1.6
Octachlorobiphenyls	Δ 2	9	5	2.4	NR	◊ 1.5	NR	5	60	NR	NR	NR	NR
Nonachlorobiphenyls	< 3	< 1	NR	NR	NR	9	27	Δ 6	3	NR	NR	NR	NR
PCB 8	< 7	< 4	◊ 10	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
PCB 31	6	3	10	2.4	19	3.7	NR	1.6	31	◊ 6	NR	NR	NR
PCB 47	5	9	15	5.5	8	2.6	NR	NR	NR	7	19	NR	NR
PCB 101	83	2	110	15	83	1.1	110	3.9	100	4	150	4	5
PCB153	58	20	80	6	71	7	100	32	150	4	110	4	24
PCB 185	< 2	< 0.9	NR	NR	NR	NR	NR	NR	NR	◊ 3	NR	NR	NR
PCB 194	Δ 2	9	5	2.5	5	3.0	NR	5	60	NR	NR	NR	NR
PCB 206	< 3	< 1	NR	NR	9	27	Δ 6	3	NR	NR	NR	NR	NR

* Relative standard deviation expressed as a percent of the mean of the triplicate analysis; NR - not reported; Δ n=2; ◊ n=1.

Table II.7. 1986 Pesticides in MUSSEL II tissue intercomparison exercise mean (n=3) results (ng/g dry weight).

Compound	NAF	RSD*	NEFSC	RSD	SEFSC	RSD BATTELLE	RSD	SAIC	RSD	TAMU	RSD	Laboratory	
												NR	NR
2,4'-DDD	<4	<2	21	48	4	NR	NR	NR	NR	NR	NR	58	2
2,4'-DDE	31	2	85	21	48	4	NR	NR	NR	NR	NR	34	2
2,4'-DDT	27	9	34	31	27	10	<26	44	44	44	44	16	28
4,4'-DDD	75	5	90	14	120	0	79	18	120	120	120	6	7
4,4'-DDE	6	7	26	27	12	5	NR	NR	NR	NR	NR	5	12
4,4'-DDT	11	5	18	41	15	8	24	15	18	18	18	5	28
Aldrin	13	4	34	13	13	0	<29	29	29	29	29	45	11
cis-Chlordane	25	2	33	20	NR	NR	NR	NR	NR	NR	NR	33	3
Dieldrin	16	4	23	22	19	6	NR	NR	NR	NR	NR	17	5
gamma-HCH	880	3	460	3	860	6	920	26	770	770	770	1	700
Heptachlor	16	0	24	18	19	13	NR	NR	NR	NR	NR	17	1
Heptachlor epoxide	120	5	120	11	NR	NR	150	28	140	140	140	2	120
Hexachlorobenzene	45	3	57	2	<3	<3	<6	<6	<6	<6	<6	20	19
Mirex	5	6	7	14	9	25	17	25	25	25	25	8	8
trans-Nonachlor	20	6	28	23	24	4	NR	NR	NR	NR	NR	27	4

* Relative standard deviation expressed as a percent of the mean of the triplicate analysis; NR - not reported; Δ n=2; ◊ n=1.

APPENDIX III

1987 TRACE ORGANIC INTERCOMPARISON EXERCISE MATERIALS AND RESULTS

NIST:	National Institute of Standards and Technology
BATTELLE:	Battelle Ocean Sciences
NAF:	NOAA/NMFS/Northwest Fisheries Science Center
NEFSC:	NOAA/NMFS/Northeast Fisheries Science Center
SAIC	Science Applications International Corporation
SEFSC:	NOAA/NMFS/Southeast Fisheries Science Center
TAMU:	Texas A&M University

Table III.1. 1987 Polycyclic aromatic hydrocarbons in Baltimore Harbor sediment (Sed87) intercomparison exercise results ($\mu\text{g/g}$ dry weight unless noted)

NIST	Date (1987) Water content (%)	7/1 50	7/1 49	7/1 NR	Mean (n=3)
Compound	Consensus value				
1-Methylnaphthalene	220	18	10	15	14
1-Methylphenanthrene	140	110	100	98	100
1,6,7-Trimethylnaphthalene	67	28	12	6	15
2,6-Dimethylnaphthalene	200	29	21	19	23
2-Methylnaphthalene	410	28	16	26	23
Acenaphthene	4.6	1.8	1.8	1.7	1.8
Acenaphthylene	4.5	4.9	3.8	3.8	4.1
Anthracene	280	270	270	250	270
Benzofluoranthenes*	1300	990	990	1100	1000
Benzol[a]pyrene	810	720	740	780	750
Benzol[e]pyrene	700	530	550	630	570
Benzol[g,h]perylene	640	490	490	560	510
Benzol[a]anthracene	680	570	640	560	590
Biphenyl	98	10	7	6	8
Chrysene	820	720	720	670	700
Dibenzol[a,h]anthracene	200	340	260	350	310
Fluoranthene	1400	1300	1300	1300	1300
Fluorene	170	60	52	72	61
Indeno[1,2,3-cd]pyrene	620	550	580	670	600
Naphthalene	1400	16	4	31	17
Perylene	480	360	320	540	410
Phenanthrene	680	680	750	690	700
Pyrene	1300	1100	1190	1200	1170

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.1. 1987 Polycyclic aromatic hydrocarbons in Baltimore Harbor sediment (Sed87) intercomparison exercise results ($\mu\text{g/g}$ dry weight unless noted) (cont.)

BATTELLE		Date (1987)		4/27		4/27		5/31		5/31		11/13		11/13		11/13	
Compound	Water content (%)	50	50	51	50	50	50	51	NR	NR	NR	NR	NR	NR	NR	NR	NR
1-Methylnaphthalene	220	270	280	280	310	340	310	270	230	280	220	240	270	240	270	270	
1-Methylphenanthrene	140	110	160	210	220	260	160	150	170	150	100	100	160	100	100	160	
1,6,7-Trimethylnaphthalene	67	NR	NR	NR	NR	NR	NR	98	91	59	68	62	76	62	76	76	
2,6-Dimethylnaphthalene	200	280	250	280	280	260	180	180	210	180	200	200	230	200	230	230	
2-Methylnaphthalene	410	600	590	570	610	640	570	550	460	570	470	470	470	470	470	410	
Acenaphthene	46	20	50	50	60	70	70	54	56	42	49	52	52	52	52	52	
Acenaphthylene	45	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
Anthracene	280	450	430	390	420	410	370	370	400	390	380	380	390	380	390	390	
Benzofluoranthenes*	1300	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
Benzo[a]pyrene	810	550	550	520	600	600	530	900	1700	1000	1000	1000	1000	1000	1000	1000	
Benzo[e]pyrene	700	530	530	500	610	610	540	850	1300	860	860	860	860	860	860	860	
Benzo[ghi]perylene	640	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
Benz[a]anthracene	680	530	530	490	680	670	610	910	1200	880	840	1100	1100	1100	1100	1100	
Biphenyl	98	150	130	130	130	120	120	150	130	130	130	130	130	130	130	130	
Chrysene	820	640	640	590	1100	1000	910	1000	1300	970	910	1300	940	940	940	940	
Dibenz[a,h]anthracene	200	110	110	100	70	80	70	170	1100	160	210	210	210	210	210	210	
Fluoranthene	1400	2300	2100	2000	2100	2100	1700	1900	1990	2100	2000	2000	2000	2000	2000	2000	
Fluorene	170	200	190	170	210	230	190	160	160	160	150	120	180	180	180	180	
Indeno[1,2,3-cd]pyrene	620	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
Naphthalene	1400	1700	1600	1700	1700	1600	1500	1500	1600	1400	1300	1600	1600	1600	1600	1600	
Perylene	480	320	330	310	360	340	330	510	830	560	550	490	450	450	450	450	
Phenanthrene	680	1000	950	910	910	980	820	790	790	860	800	580	850	850	850	850	
Pyrene	1300	2100	1900	1700	1900	1900	1700	1800	1900	2000	1900	1200	1800	1800	1800	1800	

Z R - Zero or below detection limit. NR - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.1. 1987 Polycyclic aromatic hydrocarbons in Baltimore Harbor sediment (Sed87) intercomparison exercise results ($\mu\text{g/g}$ dry weight unless noted) (cont.)

NAF	Date (1987)	Water content (%)	6/18 49	6/18 50	6/18 48	11/12 51	11/12 51	11/12 51	Mean (n=7)
Compound			Consensus value						
1-Methylnaphthalene			220	240	220	200	180	200	190
1-Methylphenanthrene			140	150	140	89	110	150	97
1,6,7-Trimethylnaphthalene	67	68	31	41	28	32	28	32	37
2,6-Dimethylnaphthalene	200	130	240	120	110	230	110	120	150
2-Methylnaphthalene	410	500	470	450	480	510	510	500	490
Acenaphthene	46	38	54	33	30	32	29	29	35
Acenaphthylene	45	33	50	43	38	76	66	76	55
Anthracene	280	310	310	300	290	280	270	270	290
Benzofluoranthenes*	1300	1500	1400	1400	1900	1900	1800	1900	1700
Benzo[a]pyrene	810	900	890	870	950	940	900	920	810
Benzo[e]pyrene	700	710	670	670	680	680	650	680	680
Benzo[ghi]perylene	640	640	630	590	690	670	630	650	640
Benz[a]anthracene	680	660	640	660	680	710	670	700	670
Biphenyl	98	97	110	120	70	85	64	80	90
Chrysene	820	940	910	860	880	890	870	890	890
Dibenz[a,h]anthracene	200	200	170	190	150	140	140	140	160
Fluoranthene	1400	1500	1500	1400	1800	1700	1700	1700	1600
Fluorene	170	200	180	150	150	150	140	140	160
Indeno[1,2,3-cd]pyrene	620	690	670	660	700	680	650	660	670
Naphthalene	1400	1500	1400	1400	1600	1600	1600	1700	1500
Perylene	480	510	470	450	480	480	450	470	470
Phenanthrene	680	690	690	650	800	760	740	760	730
Pyrene	1300	1400	1400	1300	1700	1600	1500	1600	1500

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.1. 1987 Polycyclic aromatic hydrocarbons in Baltimore Harbor sediment (Sed87) intercomparison exercise results ($\mu\text{g/g}$ dry weight unless noted) (cont.)

SAIC		Date (1987)	6/24	6/24	6/24	6/25	10/26	10/28	10/29	10/29	Mean (n=8)
	Water content (%)	60	54	53	52	51	53	51	59		
Compound	Consensus value										
1-Methylnaphthalene	220	230	200	210	290	280	330	310	280	220	
1-Methyphenanthrene	140	88	93	99	190	95	170	190	170	140	
1,6,7-Trimethylnaphthalene	67	110	42	69	180	140	ZR	74	120	100	
2,6-Dimethylnaphthalene	200	160	150	150	230	230	230	230	230	200	
2-Methylnaphthalene	410	440	400	410	490	470	540	470	490	460	
Acenaphthene	46	33	28	29	53	54	ZR	520	210	130	
Acenaphthylene	45	28	26	26	ZR	ZR	ZR	ZR	ZR	26	
Anthracene	280	190	190	190	250	250	190	270	250	220	
Benzofluoranthenes*	1300	2000	1300	1600	ZR	ZR	ZR	ZR	ZR	1600	
Benzo[a]pyrene	810	970	670	620	890	1190	580	1000	1100	880	
Benzo[e]pyrene	700	880	560	550	820	1140	460	890	1400	830	
Benzo[gh]perylene	640	1200	1000	530	ZR	ZR	ZR	ZR	ZR	910	
Benz[a]anthracene	680	620	380	610	680	950	390	760	830	650	
Biphenyl	98	69	60	62	100	110	ZR	97	98	85	
Chrysene	820	850	560	840	920	1200	560	1000	1100	880	
Dibenz[a,h]anthracene	200	310	120	120	160	44	ZR	210	270	180	
Fluoranthene	1400	800	650	810	140	1300	1300	1500	1500	1000	
Fluorene	170	110	110	110	170	170	300	180	160	170	
Indeno[1,2,3-cd]pyrene	620	1000	690	500	ZR	ZR	ZR	ZR	ZR	730	
Naphthalene	1400	1100	960	990	1200	1200	1330	1200	1180	1100	
Perylene	480	570	420	390	650	760	380	580	640	550	
Phenanthrene	680	460	420	430	370	610	570	640	680	520	
Pyrene	1300	770	630	740	1500	1238	1270	1480	1490	1100	

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.1. 1987 Polycyclic aromatic hydrocarbons in Baltimore Harbor sediment (Sed87) intercomparison exercise results (µg/g dry weight unless noted) (cont.)

SEFSC	Date (1987) Water content (%)	4/29 55	4/29 55	4/29 NR	11/16 NR	11/16 NR	Mean (n=5)
Compound		Consensus value					
1-Methylnaphthalene	220	70	66	71	240	320	150
1-Methylphenanthrene	140	200	160	ZR	190	230	200
1,6,7-Trimethylnaphthalene	67	ZR	11	5	44	45	26
2,6-Dimethylnaphthalene	200	64	70	68	250	270	140
2-Methylnaphthalene	410	120	140	150	470	490	270
Acenaphthene	46	30	49	49	36	37	40
Acenaphthylene	45	48	55	39	56	65	52
Anthracene	280	290	300	350	280	330	310
Benzofluoranthenes*	1300	970	1100	1000	490	1100	910
Benzol[al]pyrene	810	860	880	610	670	950	800
Benzo[e]pyrene	700	760	850	820	330	760	700
Benzo[gh]perylene	640	760	560	520	540	810	640
Benz[a]anthracene	680	660	1100	820	760	940	860
Biphenyl	98	76	64	81	82	86	78
Chrysene	820	910	1700	1400	790	1400	1200
Dibenz[a,h]anthracene	200	80	200	81	380	290	200
Fluoranthene	1400	1300	1000	1300	1300	1400	1300
Fluorene	170	140	120	140	160	160	140
Indeno[1,2,3-cd]pyrene	620	500	440	440	508	770	530
Naphthalene	1400	1400	1400	1400	1400	1500	1400
Perylene	480	500	440	460	400	540	470
Phenanthrene	680	590	470	600	620	700	600
Pyrene	1300	1200	980	1200	1100	1300	1200

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.1. 1987 Polycyclic aromatic hydrocarbons in Baltimore Harbor sediment (Sed87) intercomparison exercise results (μg/g dry weight unless noted) (cont.)

TAMU	Date (1987)	5/31	5/31	5/31	11/16	11/16	11/16	11/16
	Water content (%)	52	52	52	51	50	53	53
Compound	Consensus value							
1-Methylnaphthalene	220	340	330	340	510	330	370	380
1-Methylphenanthrene	140	160	150	150	110	130	170	390
1,6,7-Trimethylnaphthalene	67	150	150	140	120	140	170	150
2,6-Dimethylnaphthalene	200	240	230	240	190	200	290	230
2-Methylnaphthalene	410	600	590	590	610	690	710	700
Acenaphthene	4.6	6.0	6.1	6.0	6.5	5.6	29	71
Acenaphthylene	4.5	16.0	17.0	16.0	12.0	8.7	7.8	52
Anthracene	280	290	300	290	310	270	240	290
Benzofluoranthenes*	1300	1800	1800	1800	1400	160	1600	1500
Benzo[a]pyrene	810	830	850	840	940	870	890	770
Benzo[e]pyrene	700	580	600	590	770	730	730	670
Benzo[gh]perylene	640	820	850	820	840	830	790	760
Benz[a]anthracene	680	710	700	710	760	650	640	740
Biphenyl	98	110	110	110	94	78	93	150
Chrysene	820	860	800	790	840	790	800	730
Dibenz[a,h]anthracene	200	420	390	410	334	310	270	270
Fluoranthene	1400	1600	1700	1600	1400	1600	1600	1790
Fluorene	170	160	160	160	190	150	160	200
Indeno[1,2,3-cd]pyrene	620	800	830	840	760	730	700	630
Naphthalene	1400	1400	1400	1400	1900	1370	160	1800
Perylene	480	680	680	690	560	500	510	560
Phenanthrene	680	600	610	590	750	600	670	800
Pyrene	1300	1620	1700	1600	1300	1500	1500	1700

Z R - Zero or below detection limit. N R - Not reported.
 * Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.1. 1987 Polycyclic aromatic hydrocarbons in Baltimore Harbor sediment (Sed87) intercomparison exercise results (µg/g dry weight unless noted) (cont.)

TAMU	Date (1987)	1/1/16 Water content (%)	1/1/16 52	1/1/16 52	1/1/16 52	1/1/16 52	Mean (n=14)
Compound							
1-Methylnaphthalene	230	480	320	410	300	360	360
1-Methylphenanthrene	110	120	120	140	100	130	140
1,6,7-Trimethylnaphthalene	140	120	130	170	120	140	140
2,6-Dimethylnaphthalene	260	250	270	280	240	280	250
2-Methylnaphthalene	400	470	570	710	550	620	620
Acenaphthene	60	75	59	68	55	68	60
Acenaphthylene	70	99	59	56	53	56	95
Anthracene	240	270	240	260	260	260	270
Benzofluoranthenes*	1700	1600	1700	1600	1500	1500	1700
Benzol[a]pyrene	1000	1100	920	900	870	920	910
Benzol[e]pyrene	860	810	710	700	690	720	720
Benzol[ghi]perylene	730	740	820	730	650	750	770
Benz[a]anthracene	600	760	620	630	590	610	680
Biphenyl	130	130	140	120	100	120	110
Chrysene	830	860	790	820	850	840	810
Dibenzol[a,h]anthracene	220	260	240	200	140	210	280
Fluoranthene	1400	1300	1400	1500	1500	1400	1500
Fluorene	160	160	140	160	150	150	160
Indeno[1,2,3-cd]pyrene	600	630	880	730	640	740	720
Naphthalene	1600	1400	1500	1600	1400	1600	1500
Perylene	570	620	530	540	540	550	570
Phenanthrene	710	710	700	760	700	730	680
Pyrene	1400	1300	1400	1400	1440	1400	1500

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted)

NIST		Date (1987) Water content (%)	7/3 50	7/3 4.9	7/3 NR	Mean (n=3)
Compound	Consensus value					
PCB 8	5	ZR	ZR	ZR	ZR	
PCB 18	6	7	5	6	6	
PCB 28	19	17	18	18	18	
PCB 44	13	8	7	7	7	
PCB 52	20	17	17	18	18	
PCB 66	21	12	13	11	12	
PCB 77	52	ZR	ZR	ZR	ZR	
PCB 101	24	25	25	22	24	
PCB 105	7	6	5	5	5	
PCB 118	18	19	17	20	19	
PCB 126	4	5	4	4	4	
PCB 128	5	ZR	ZR	ZR	ZR	
PCB 138	27	28	21	20	23	
PCB 153	31	22	21	25	23	
PCB 170	17	5	5	6	5	
PCB 180	19	19	20	20	20	
PCB 187	15	13	15	12	14	
PCB 195	5	ZR	ZR	ZR	ZR	
PCB 206	9	3	3	4	3	
PCB 209	9	7	6	7	7	

NIST did not report PCB concentration by degree of chlorination.

NOTE: PCB 126 identification questionable.

Z R - Zero or below detection limit.

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

BATTELLE										Mean (n=8)
Date (1987)	4/27	4/27	4/27	11/12	11/13	11/13	11/13	11/13	11/13	
Water content (%)	50	50	51	NR	NR	NR	NR	NR	NR	
Compound	Consensus value									
PCB 8	5	NR	NR	NR	3	4	4	3	2	2
PCB 18	6	4	4	4	8	9	10	8	6	6
PCB 28	19	NR	NR	NR	25	27	28	23	22	22
PCB 44	13	9	8	9	16	18	18	14	13	13
PCB 52	20	13	12	12	26	29	30	24	21	21
PCB 66	21	10	10	1	44	48	47	38	39	39
PCB 77	52	44	41	46	NR	NR	NR	NR	NR	NR
PCB 101	24	14	13	14	30	34	34	26	24	24
PCB 105	7	9	8	9	ZR	ZR	ZR	ZR	ZR	ZR
PCB 118	18	11	10	11	28	29	28	23	29	29
PCB 126	4	3	2	3	NR	NR	NR	NR	NR	NR
PCB 128	5	4	3	3	6	6	6	5	5	5
PCB 138	27	15	14	15	41	38	43	33	30	30
PCB 153	31	14	13	14	52	57	56	43	41	41
PCB 170	17	5	4	5	14	13	13	10	10	10
PCB 180	19	11	10	12	29	30	30	21	22	22
PCB 187	15	8	7	7	20	18	21	15	14	14
PCB 195	5	1	2	2	7	7	7	5	5	5
PCB 206	9	8	7	7	17	18	17	11	12	12
PCB 209	9	7	5	5	13	16	15	10	11	11

NOTE: Concentration listed for PCB 77 is probably primarily PCB 110.

ZR - Zero or below detection limit.

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

BATTELLE		Date (1987)	4/27	4/27	4/27	11/12	11/13	11/13	11/13	Mean (n=8)
Degree of chlorination	Consensus value									
Dichlorobiphenyls	4	9	9	9	3	4	4	3	2	5
Trichlorobiphenyls	40	24	24	24	54	55	55	30	46	39
Tetrachlorobiphenyls	149	139	144	123	191	214	201	160	152	165
Pentachlorobiphenyls	125	78	70	74	193	195	193	177	148	141
Hexachlorobiphenyls	117	56	59	55	179	169	172	160	117	121
Heptachlorobiphenyls	74	40	53	41	83	103	104	78	74	72
Octachlorobiphenyls	18	13	15	10	39	42	41	28	30	27
Nonachlorobiphenyls	8	7	7	6	17	18	17	11	11	12
Total PCBs	556	373	385	347	772	816	802	658	592	593

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

NAF	Date (1987)	Water content (%)	6/18 4.9	6/18 5.0	6/18 4.8	11/12 5.1	11/12 5.1	Mean (n=6)
Compound		Consensus value						
PCB 8		5	ZR	5	10	NR	NR	10
PCB 18		6	5	ZR	5	5	5	5
PCB 28		19	17	18	17	22	20	16
PCB 44		13	12	14	12	20	18	19
PCB 52		20	18	20	18	23	27	21
PCB 66		21	14	16	15	36	23	33
PCB 77		52	NR	NR	NR	NR	NR	NR
PCB 101		24	21	22	21	33	34	30
PCB 105		7	4	4	2	6	6	5
PCB 118		18	15	15	14	20	15	14
PCB 126		4	ZR	ZR	NR	NR	NR	16
PCB 128		5	3	3	17	17	14	10
PCB 138		27	19	19	19	34	35	26
PCB 153		31	28	25	28	39	40	36
PCB 170		17	12	14	15	27	26	21
PCB 180		19	15	17	21	33	32	27
PCB 187		15	10	10	11	23	23	19
PCB 195		5	3	7	14	7	7	7
PCB 206		9	10	17	28	9	6	6
PCB 209		9	12	26	47	25	22	26

Z R - Zero or below detection limit.

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

NAF	Date (1987)	Consensus value	6/18	6/18	6/18	11/12	11/12	11/12	Mean (n=6)
Dichlorobiphenyls	4	ZR	10			NR			10
Trichlorobiphenyls	40	57	61	59	55	68	66	61	
Tetrachlorobiphenyls	149	170	190	170	210	200	210	192	
Pentachlorobiphenyls	125	150	160	150	220	260	190	188	
Hexachlorobiphenyls	117	140	150	160	230	240	230	192	
Heptachlorobiphenyls	74	72	79	94	190	190	150	129	
Octachlorobiphenyls	18	53	87	110	81	100	88	86	
Nonachlorobiphenyls	8	10	17	28	9	6	6	13	
Total PCBs	556	664	770	828	829	1090	962	856	

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

SAIC	Date (1987)	Water content (%)	6/18 60	6/18 54	6/18 53	10/21 52	10/22 51	Mean (n=5)
Compound		Consensus value						
PCB 8		5	6	4	5	NR	NR	5
PCB 18		6	8	5	7	NR	NR	7
PCB 28		19	24	16	20	NR	NR	14
PCB 44		13	17	11	14	NR	NR	20
PCB 52		20	21	14	19	NR	NR	18
PCB 66		21	ZR	ZR	ZR	NR	NR	
PCB 77		52	46	35	45	NR	NR	42
PCB 101		24	28	19	24	NR	NR	24
PCB 105		7	7	5	6	NR	NR	6
PCB 118		18	19	14	18	NR	NR	17
PCB 126		4	ZR	ZR	ZR	NR	NR	
PCB 128		5	6	5	6	NR	NR	6
PCB 138		27	29	21	28	NR	NR	26
PCB 153		31	32	24	32	NR	NR	29
PCB 170		17	33	38	45	NR	NR	38
PCB 180		19	17	15	20	NR	NR	17
PCB 187		15	22	19	21	NR	NR	20
PCB 195		5	6	9	11	NR	NR	9
PCB 206		9	11	19	21	NR	NR	17
PCB 209		9	4	12	9	NR	NR	8

NOTE: PCB 77 identification questionable, probably PCB 110.

Z R - Zero or below detection limit.

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

SAIC	Date (1987)	6/18	6/18	6/18	10/21	10/22	Mean (n=5)
Degree of chlorination	Consensus value						
Dichlorobiphenyls	4	NR	NR	NR	4	3	3
Trichlorobiphenyls	40	NR	NR	NR	22	22	22
Tetrachlorobiphenyls	149	NR	NR	NR	100	108	104
Pentachlorobiphenyls	125	NR	NR	NR	52	59	56
Hexachlorobiphenyls	117	NR	NR	NR	52	63	58
Heptachlorobiphenyls	74	NR	NR	NR	32	38	35
Octachlorobiphenyls	18	NR	NR	NR	13	15	14
Nonachlorobiphenyls	8	NR	NR	NR	5	5	5
Total PCBs	556	NR	NR	NR	281	314	297

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

SEFSC	Date (1987) Water content (%)	4/29 55	4/29 55	4/29 55	11/16 NR	11/16 NR	Mean (n=5)
Compound	Consensus value						
PCB 8	5	7	21	31	9	9	15
PCB 18	6	6	4	3	4	4	4
PCB 28	19	21	17	17	14	19	11
PCB 44	13	12	9	10	9	12	17
PCB 52	20	18	14	15	13	18	16
PCB 66	21	17	14	8	10	28	15
PCB 77	52	ZR	ZR	ZR	ZR	ZR	
PCB 101	24	24	21	21	17	22	21
PCB 105	7	ZR	ZR	ZR	ZR	ZR	
PCB 118	18	16	14	14	12	17	15
PCB 126	4	ZR	ZR	ZR	ZR	ZR	
PCB 128	5	3	3	3	2	3	3
PCB 138	27	27	21	22	17	24	22
PCB 153	31	ZR	ZR	ZR	25	33	29
PCB 170	17	15	13	12	10	13	13
PCB 180	19	16	14	14	12	17	15
PCB 187	15	12	10	10	9	13	11
PCB 195	5	3	3	2	2	3	3
PCB 206	9	5	5	4	3	5	5
PCB 209	9	8	8	7	3	4	6

SEFSC did not report PCB concentration by degree of chlorination.

NOTE: PCB 66 corrected for co-eluting congener.
ZR - Zero or below detection limit.

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

TAMU		Date (1987)	Water content (%)	5/30 52	5/30 52	5/30 NR	5/30 NR	5/30 NR	5/30 NR	11/30 NR	11/30 NR
Compound	Consensus value										
PCB 8	5			8	9	9	8	3	10	8	4
PCB 18	6			9	9	10	9	9	7	5	7
PCB 28	19			16	17	21	15	15	18	13	16
PCB 44	13			14	16	17	13	13	14	13	18
PCB 52	20			34	35	37	37	26	26	22	19
PCB 66	21			19	20	26	16	16	18	17	15
PCB 77	52			69	90	97	69	61	69	NR	NR
PCB 101	24			26	32	35	26	27	27	20	24
PCB 105	7			16	11	10	11	7	14	5	8
PCB 118	18			28	26	28	21	21	23	16	18
PCB 126	4			ZR	ZR	ZR	ZR	ZR	NR	NR	NR
PCB 128	5			4	4	4	4	2	4	3	3
PCB 138	27			28	31	32	27	30	29	19	29
PCB 153	31			34	38	43	32	36	35	22	24
PCB 170	17			28	34	26	33	10	29	5	39
PCB 180	19			23	23	22	23	22	24	9	15
PCB 187	15			16	17	18	14	13	16	7	13
PCB 195	5			6	6	4	5	4	4	2	2
PCB 206	9			7	7	5	6	7	7	2	3
PCB 209	9			11	9	8	11	11	10	1	9

NOTE: PCB 77 identification questionable, probably PCB 110.

Z R - Zero or below detection limit.

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

TAMU	Date (1987)	11/30 NR	11/30 NR	11/30 NR	11/30 NR	11/30 NR	11/30 NR	Mean (n=16)
Compound								
PCB 8	6	6	5	3	4	6	4	5
PCB 18	4	7	6	6	7	5	3	6
PCB 28	10	15	15	12	12	13	14	14
PCB 44	10	14	17	11	12	12	12	13
PCB 52	19	28	27	19	18	16	25	22
PCB 66	11	16	18	13	13	10	13	13
PCB 77	NR	0						
PCB 101	23	25	35	24	20	24	24	25
PCB 105	7	7	11	11	14	5	7	9
PCB 118	24	19	27	20	17	19	18	20
PCB 126	NR	0						
PCB 128	5	5	5	4	4	6	4	4
PCB 138	39	49	70	43	24	33	29	39
PCB 153	45	44	49	29	22	46	34	38
PCB 170	21	50	33	17	23	13	29	17
PCB 180	25	26	29	25	20	23	20	22
PCB 187	25	28	26	16	14	15	16	19
PCB 195	4	5	4	4	4	4	4	4
PCB 206	7	6	5	7	7	6	5	6
PCB 209	15	16	6	10	10	6	7	9
								10

NOTE: PCB 77 identification questionable, probably PCB 110.
 Z R - Zero or below detection limit.

Table III.2. 1987 Polychlorinated biphenyls in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

TAMU											
Date (1987)		5/30	5/30	5/30	5/30	5/30	5/30	5/30	5/30	11/30	11/30
Degree of chlorination	Consensus value										
Dichlorobiphenyls	4	12	13	12	11	5	14	18	14		
Trichlorobiphenyls	4.0	74	79	83	96	50	75	32	52		
Tetrachlorobiphenyls	14.9	130	140	158	122	100	127	202	164		
Pentachlorobiphenyls	125	187	230	252	174	153	189	118	164		
Hexachlorobiphenyls	117	153	168	177	137	140	149	99	123		
Heptachlorobiphenyls	74	107	115	92	95	63	96	26	86		
Octachlorobiphenyls	18	29	28	22	29	24	28	10	18		
Nonachlorobiphenyls	8	7	6	5	6	7	7	2	3		
Total PCBs	556	708	786	811	681	553	696	507	632		
Date (1987)	11/30	11/30	11/30	11/30	11/30	11/30	11/30	11/30	11/30		
Degree of chlorination										Mean (n=16)	
Dichlorobiphenyls	12	16	13	11	14	13	11	13	13		
Trichlorobiphenyls	32	44	45	35	44	42	39	40	40		
Tetrachlorobiphenyls	152	178	219	187	211	155	182	158	180		
Pentachlorobiphenyls	239	182	224	151	136	186	158	137	177		
Hexachlorobiphenyls	181	173	209	136	114	152	145	148	157		
Heptachlorobiphenyls	94	127	130	98	94	117	85	73	102		
Octachlorobiphenyls	26	36	25	26	30	22	28	27	28		
Nonachlorobiphenyls	7	6	5	7	7	6	5	7	6		
Total PCBs	758	778	877	660	661	699	659	611	713		

Table III.3. 1987 Pesticides in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted).

NIST	Date (1987) Water content (%)	7/3 50	7/3 49	7/3 NR	Mean (n=3)
Compound	Consensus value				
2,4'-DDD	5	2	2	1	1.6
2,4'-DDE		ZR	ZR	ZR	
2,4'-DDT		ZR	ZR	ZR	
4,4'-DDD	11	10	10	10	10
4,4'-DDE	13	9	8	11	9
4,4'-DDT	2	2	1	1	1
cis-Chlordane	3	2	2	2	2
Aldrin		ZR	ZR	ZR	
Dieldrin	3	ZR	ZR	ZR	
gamma-HCH		ZR	ZR	ZR	
Heptachlor	2	4	3	4	3
Heptachlor epoxide		4	4	4	4
Hexachlorobenzene	27	34	32	37	34
Mirex		ZR	ZR	ZR	
trans-Nonachlor	1	1	1	2	1

ZR - Zero or below detection limit. NR - Not reported.

Table III.3. 1987 Pesticides in Baltimore Harbor sediment (Sed87) intercomparison exercise results ng/g dry weight unless noted.
(cont.)

BATTELLE										Mean (n=8)
Date (1987)	4/27		4/27		11/13		11/13		11/13	
Water content (%)	50	50	51	NR	NR	NR	NR	NR	NR	
Compound	Consensus value									
2,4'-DDD	5	NR	NR	NR	NR	ZR	ZR	ZR	ZR	5
2,4'-DDE	5	NR	NR	NR	NR	ZR	ZR	ZR	ZR	5
2,4'-DDT	11	11	14	14	39	28	37	31	9	23
4,4'-DDD	11	9	9	10	22	22	22	18	18	16
4,4'-DDE	13	7	6	8	10	11	10	8	9	9
4,4'-DDT	2	7	6	8	10	11	10	8	9	9
cis-Chlordane	3	6	6	7	3	2	2	3	3	4
Aldrin	NR	NR	NR	ZR	ZR	ZR	ZR	ZR	ZR	ZR
Dieldrin	3	7	7	9	15	16	16	12	11	12
gamma-HCH	NR	NR	NR	NR	ZR	ZR	ZR	ZR	ZR	ZR
Heptachlor	2	NR	NR	NR	ZR	ZR	ZR	ZR	ZR	ZR
Heptachlor epoxide	NR	NR	NR	ZR	ZR	ZR	ZR	ZR	ZR	ZR
Hexachlorobenzene	27	26	25	25	44	50	50	38	37	37
Mirex	2	1	1	2	1	2	1	1	1	1
trans-Nonachlor	1	1	2	2	3	2	2	2	1	1

Z R - Zero or below detection limit. N R - Not reported.

Table III.3. 1987 Pesticides in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted).
(cont.)

NAF	Date (1987)	Water content (%)	6/18 49	6/18 50	6/18 48	11/12 51	11/12 51	11/12 51	Mean (n=7)
Compound		Consensus value							
2,4'-DDD		5	ZR	ZR	3	11	10	8	8
2,4'-DDE		5	ZR	ZR	5	10	11	10	8
2,4'-DDT		5	ZR	ZR	NR	NR	NR	NR	NR
4,4'-DDD	11	5	ZR	ZR	5	18	18	18	16
4,4'-DDE	13	7	ZR	ZR	8	16	17	16	12
4,4'-DDT	2	ZR	ZR	ZR	3	ZR	ZR	ZR	21
cis-Chlordane	3	3	ZR	ZR	2	3	3	ZR	13
Aldrin		ZR	ZR	ZR	ZR	ZR	ZR	ZR	3
Dieldrin	3	2	ZR	ZR	2	ZR	ZR	ZR	3
gamma-HCH		ZR	ZR	ZR	ZR	ZR	ZR	ZR	3
Heptachlor	2	3	ZR	ZR	2	ZR	ZR	ZR	5
Heptachlor epoxide		2	ZR	ZR	2	ZR	ZR	ZR	2
Hexachlorobenzene	27	27	ZR	ZR	28	33	32	32	30
Mirex		1	ZR	ZR	4	ZR	ZR	ZR	4
trans-Nonachlor						ZR	ZR	ZR	4

NOTE: 4,4'-DDD concentration includes that of 2,4'-DDT.

Z R - Zero or below detection limit. N R - Not reported.

Table III.3. 1987 Pesticides in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted).
 (cont.)

S A I C		Compound	Consensus value	Mean (n=5)				
Date (1987)	Water content (%)			6/18 60	6/18 54	6/18 53	5/5 52	5/5 51
2,4'-DDD	5	4	ZR	ZR	ZR	ZR	12	8
2,4'-DDE		ZR	ZR	ZR	ZR	ZR	6	6
2,4'-DDT		ZR	ZR	ZR	ZR	ZR		
4,4'-DDD	11	13	10	10	7	15	11	
4,4'-DDE	13	19	13	17	6	8	13	
4,4'-DDT	2	3	3	2	3	4	3	
Aldrin	3	8	2	4	2	1	3	
cis-Chlordane		4	3	3	ZR	ZR	3	
Dieldrin	3	4	3	2	8	9	5	
gamma-HCH		1	1	1	ZR	ZR	1	
Heptachlor	2	1	1	1	1	1	1	
Heptachlor epoxide		ZR	ZR	ZR	ZR	ZR		
Hexachlorobenzene	27	2	6	20	2	3	7	
Mirex		3	3	3	ZR	ZR	3	
trans-Nonachlor	1	3	2	1	ZR	1	2	

Z R - Zero or below detection limit. N R - Not reported.

Table III.3. 1987 Pesticides in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted).
(cont.)

SEFSC		Date (1987)	4/29	4/29	4/29	11/16	11/16	Mean (n=5)
		Water content (%)	55	55	55	NR	NR	ZR
Compound	Consensus value							
2,4'-DDD	5	ZR	ZR	ZR	ZR	6	6	
2,4'-DDE		ZR	ZR	ZR	ZR	ZR	ZR	
2,4'-DDT		ZR	ZR	ZR	ZR	ZR	ZR	
4,4'-DDD	11	11	9	9	9	11	10	
4,4'-DDE	13	9	8	8	12	15	15	10
4,4'-DDT	2	ZR	ZR	ZR	ZR	ZR	ZR	
Aldrin	3	ZR	ZR	ZR	ZR	ZR	ZR	
cis-Chlordane	3	3	3	3	3	4	3	
Dieldrin	3	ZR	ZR	ZR	ZR	ZR	ZR	
gamma-HCH		ZR	2	ZR	ZR	ZR	ZR	
Heptachlor	2		2	2	ZR	ZR	ZR	2
Heptachlor epoxide		ZR	ZR	ZR	ZR	ZR	ZR	
Hexachlorobenzene	27	36	30	31	3	7	21	
Mirex		ZR	ZR	ZR	ZR	ZR	ZR	
trans-Nonachlor	1	1	1	1	1	1	1	1

NOTE: 4,4'-DDE corrected for coeluting PCB.

Z R - Zero or below detection limit. N R - Not reported.

Table III.3. 1987 Pesticides in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted).
(cont.)

TAMU		Date (1987)		5/31		5/31		5/31		5/31	
Compound	Consensus value	Water content (%)	52	52	52	NR	NR	NR	NR	NR	NR
2,4'-DDD	5	ZR	2	ZR	4	ZR	ZR	ZR	ZR	NR	3
2,4'-DDE		1	1	1	1	NR	NR	NR	NR	1	ZR
2,4'-DDT	11	12	13	15	10	11	12	13	13	1	ZR
4,4'-DDD	11	13	15	18	13	14	13	14	14	10	
4,4'-DDE	13	13	15	18	13	14	13	14	14	14	
4,4'-DDT	2	1	1	1	1	1	1	1	1	1	2
Aldrin	3	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR
cis-Chlordane	3	4	4	3	3	2	3	2	2	2	4
Dieldrin	3	2	3	3	2	2	NR	2	2	2	4
gamma-HCH		ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR
Heptachlor	2	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR
Heptachlor epoxide		ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR
Hexachlorobenzene	27	38	41	45	38	33	33	42	NR	NR	NR
Mirex		ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR
trans-Nonachlor	1	1	1	1	1	1	1	1	NR	1	1

Z R - Zero or below detection limit. NR - Not reported.

Table III.3. 1987 Pesticides in Baltimore Harbor sediment (Sed87) intercomparison exercise results (ng/g dry weight unless noted).
 (cont.)

TAMU	Date (1987)	12/1 NR	12/1 NR	12/1 NR	12/1 NR	12/1 NR	12/1 NR	Mean (n=16)
Water content (%)								
2,4'-DDD	3	4	5	3	3	2	4	3
2,4'-DDE	ZR	ZR	ZR	ZR	ZR	ZR	ZR	1
2,4'-DDT	ZR	ZR	1	1	ZR	ZR	ZR	1
4,4'-DDD	18	12	18	10	10	15	10	8
4,4'-DDE	14	14	17	10	13	11	14	12
4,4'-DDT	2	2	5	2	3	2	3	2
Aldrin	ZR	ZR	ZR	ZR	ZR	ZR	ZR	2
cis-Chlordane	3	6	4	3	3	2	3	3
Dieldrin	1	5	4	3	4	1	3	2
gamma-HCH	ZR	ZR	ZR	ZR	ZR	ZR	ZR	3
Heptachlor	ZR	ZR	ZR	ZR	ZR	ZR	ZR	2
Heptachlor epoxide	ZR	ZR	ZR	ZR	ZR	ZR	ZR	3
Hexachlorobenzene	24	NR	23	17	26	16	32	31
Mirex	ZR	2	1	1	2	ZR	1	1
trans-Nonachlor	1	1	1	1	1	1	1	1

Z R - Zero or below detection limit. N R - Not reported.

Table III.4. 1987 Polycyclic aromatic hydrocarbons in mussel tissue (Ti87) intercomparison exercise results ($\mu\text{g/g}$ dry weight unless noted)

NIST	Date (1987)	7/7 87	7/7 87
Compound			
1-Methylnaphthalene		N A	N A
1-Methylphenanthrene		N A	N A
1,6,7-Trimethylnaphthalene		N A	N A
2,6-Dimethylnaphthalene		N A	N A
2-Methylnaphthalene		N A	N A
Acenaphthene		N A	N A
Acenaphthylene		N A	N A
Anthracene		Z R	Z R
Benzofluoranthenes*		4	3
Benz[a]pyrene		3	4
Benz[e]pyrene		N A	N A
Benz[gh]perylene		12	14
Benz[a]anthracene		5	5
Biphenyl		N A	N A
Chrysene		16	14
Dibenz[a, h]anthracene		N A	N A
Fluoranthene		21	22
Fluorene		N A	N A
Indeno[1,2,3-cd]pyrene		N A	N A
Naphthalene		N A	N A
Perylene		3	4
Phenanthrene		3	2
Pyrene		18	19

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.4. 1987 Polycyclic aromatic hydrocarbons in mussel tissue (Ti87) intercomparison exercise results ($\mu\text{g/g}$ dry weight unless noted) (cont.)

BATTELLE	Date (1987)	4/27 89	4/27 90	4/27 90	4/27 90
Compound					
1-Methylnaphthalene	ZR	ZR	ZR	ZR	ZR
1-Methylphenanthrene	ZR	ZR	ZR	ZR	ZR
1,6,7-Trimethylnaphthalene	ZR	ZR	ZR	ZR	ZR
2,6-Dimethylnaphthalene	ZR	ZR	ZR	ZR	ZR
2-Methylnaphthalene	ZR	ZR	ZR	ZR	ZR
Acenaphthene	ZR	ZR	ZR	ZR	ZR
Acenaphthylene	ZR	ZR	ZR	ZR	ZR
Anthracene	ZR	ZR	ZR	ZR	ZR
Benzofluoranthenes*	ZR	ZR	ZR	ZR	ZR
Benzo[a]pyrene	ZR	ZR	ZR	ZR	ZR
Benzo[e]pyrene	ZR	ZR	ZR	ZR	ZR
Benzo[gh]perylene	ZR	ZR	ZR	ZR	ZR
Benz[a]anthracene	ZR	ZR	ZR	ZR	ZR
Biphenyl	10	ZR	ZR	ZR	ZR
Chrysene	ZR	ZR	ZR	ZR	ZR
Dibenz[a,h]anthracene	ZR	ZR	ZR	ZR	ZR
Fluoranthene	20	10	10	20	20
Fluorene	ZR	ZR	ZR	ZR	ZR
Indeno[1,2,3-cd]pyrene	ZR	ZR	ZR	ZR	ZR
Naphthalene	10	10	10	10	10
Perylene	ZR	ZR	ZR	ZR	ZR
Phenanthrene	ZR	ZR	ZR	ZR	ZR
Pyrene	10	10	10	10	10

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.4. 1987 Polycyclic aromatic hydrocarbons in mussel tissue (Ti87) intercomparison exercise results ($\mu\text{g/g}$ dry weight unless noted) (cont.)

NAF	Date (1987)	6/18 90	6/18 90	6/18 90
Compound				
1-Methylnaphthalene	ZR	ZR	ZR	ZR
1-Methylphenanthrene	ZR	ZR	ZR	ZR
1,6,7-Trimethylnaphthalene	ZR	ZR	ZR	ZR
2,6-Dimethylnaphthalene	ZR	ZR	ZR	ZR
2-Methylnaphthalene	ZR	ZR	ZR	ZR
Acenaphthene	ZR	ZR	ZR	ZR
Acenaphthylene	ZR	ZR	ZR	ZR
Anthracene	ZR	ZR	ZR	ZR
Benzofluoranthenes*	ZR	ZR	ZR	ZR
Benzo[a]pyrene	ZR	ZR	ZR	ZR
Benzo[e]pyrene	ZR	ZR	ZR	ZR
Benzo[ghi]perylene	ZR	ZR	ZR	ZR
Benz[a]anthracene	ZR	ZR	ZR	ZR
Biphenyl	ZR	ZR	ZR	ZR
Chrysene	ZR	ZR	ZR	ZR
Dibenz[a,h]anthracene	ZR	ZR	ZR	ZR
Fluoranthene	ZR	ZR	ZR	ZR
Fluorene	ZR	ZR	ZR	ZR
Indeno[1,2,3-cd]pyrene	ZR	ZR	ZR	ZR
Naphthalene	ZR	ZR	ZR	ZR
Perylene	ZR	ZR	ZR	ZR
Phenanthrene	ZR	ZR	ZR	ZR
Pyrene	ZR	ZR	ZR	ZR

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.4. 1987 Polycyclic aromatic hydrocarbons in mussel tissue (Ti87) intercomparison exercise results ($\mu\text{g/g}$ dry weight unless noted) (cont.)

SAIC	Date (1987)	6/23	6/23	6/23	6/23
	Water content (%)	89	91	90	90
Compound					
1-Methylnaphthalene	ZR	ZR	ZR	ZR	ZR
1-Methylphenanthrene	ZR	ZR	ZR	ZR	ZR
1,6,7-Trimethylnaphthalene	ZR	ZR	ZR	ZR	ZR
2,6-Dimethylnaphthalene	ZR	ZR	ZR	ZR	ZR
2-Methylnaphthalene	ZR	ZR	ZR	ZR	ZR
Acenaphthene	ZR	ZR	ZR	ZR	ZR
Acenaphthylene	ZR	ZR	ZR	ZR	ZR
Anthracene	341	611	611	148	148
Benzofluoranthenes*	ZR	ZR	ZR	ZR	ZR
Benzo[a]pyrene	ZR	ZR	ZR	ZR	ZR
Benzo[e]pyrene	ZR	ZR	ZR	ZR	ZR
Benzo[ghi]perylene	ZR	ZR	ZR	ZR	ZR
Benz[a]anthracene	ZR	ZR	ZR	ZR	ZR
Biphenyl	ZR	ZR	ZR	ZR	ZR
Chrysene	ZR	ZR	ZR	ZR	ZR
Dibenz[a,h]anthracene	ZR	ZR	ZR	ZR	ZR
Fluoranthene	ZR	ZR	ZR	ZR	ZR
Fluorene	ZR	ZR	ZR	ZR	ZR
Indeno[1,2,3-cd]pyrene	ZR	ZR	ZR	ZR	ZR
Naphthalene	ZR	ZR	ZR	ZR	ZR
Perylene	ZR	ZR	ZR	ZR	ZR
Phenanthrene	ZR	ZR	ZR	ZR	ZR
Pyrene	1060	2260	2260	549	549

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benz[k]fluoranthene.

Table III.4. 1987 Polycyclic aromatic hydrocarbons in mussel tissue (Ti87) intercomparison exercise results ($\mu\text{g/g}$ dry weight unless noted) (cont.)

SEFSC	Date (1987)	4/15 Water content (%)	4/15 90	4/15 90	4/15 90
Compound					
1-Methylnaphthalene		76		ZR	461
1-Methylphenanthrene		18500	24900	9	18700
1,6,7-Trimethylnaphthalene		ZR	ZR	ZR	ZR
2,6-Dimethylnaphthalene		1090	1070		469
2-Methylnaphthalene		ZR	ZR	ZR	ZR
Acenaphthene		ZR	ZR	ZR	ZR
Acenaphthylene		ZR	ZR	ZR	ZR
Anthracene		ZR	ZR	ZR	ZR
Benzofluoranthenes*		177	129		156
Benz[a]pyrene		ZR	ZR	ZR	ZR
Benz[e]pyrene		ZR	ZR	ZR	ZR
Benz[ghi]perylene		ZR	ZR	ZR	ZR
Benz[a]anthracene		ZR	ZR	ZR	ZR
Biphenyl		ZR	ZR	ZR	ZR
Chrysene		ZR	ZR	ZR	ZR
Dibenz[a,h]anthracene		ZR	ZR	ZR	ZR
Fluoranthene		936	868		782
Fluorene		ZR	ZR	ZR	ZR
Indeno[1,2,3-cd]pyrene		ZR	ZR	ZR	ZR
Naphthalene		200	ZR		323
Perylene		184	258	NR	NR
Phenanthrene		ZR	173	59	59
Pyrene		182	150	148	148

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.4. 1987 Polycyclic aromatic hydrocarbons in mussel tissue (Ti87) intercomparison exercise results ($\mu\text{g/g}$ dry weight unless noted) (cont.)

TAMU	Date (1987)	Water content (%)	5/31	5/31	5/31
Compound			89	89	89
1-Methylnaphthalene	ZR		ZR	ZR	ZR
1-Methylphenanthrene	ZR		ZR	ZR	ZR
1,6,7-Trimethylnaphthalene	ZR		ZR	ZR	ZR
2,6-Dimethylnaphthalene	ZR		ZR	ZR	ZR
2-Methylnaphthalene	ZR		ZR	ZR	ZR
Acenaphthene	ZR		ZR	ZR	ZR
Acenaphthylene	1		1	1	1
Anthracene	ZR		ZR	ZR	ZR
Benzofluoranthenes*	10		10	10	9
Benz[a]pyrene	1		1	1	1
Benz[e]pyrene	7		7	7	6
Benz[gh]perylene	ZR		ZR	ZR	ZR
Benz[a]anthracene	3		3	3	2
Biphenyl	ZR		ZR	ZR	ZR
Chrysene	6		6	6	5
Dibenz[a,h]anthracene	ZR		ZR	ZR	ZR
Fluoranthene	12		11	11	11
Fluorene	ZR		ZR	ZR	ZR
Indeno[1,2,3-cd]pyrene	ZR		ZR	ZR	ZR
Naphthalene	ZR		ZR	ZR	ZR
Perylene	ZR		ZR	ZR	ZR
Phenanthrene	3		3	3	2
Pyrene	10		10	10	9

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)

NIST	Date (1987) Water content (%)	7/7 87	7/7 87	7/7 87	Mean (n=3)
Compound	Consensus value				
PCB 8		2	ZR	1	1
PCB 18	5	4	1	4	3
PCB 28	5	6	2	2	3
PCB 44	6	3	1	1	2
PCB 52	7	8	4	4	5
PCB 66	12	12	11	11	11
PCB 77	29	22	20	20	20
PCB 101	18	19	20	17	19
PCB 105	8	4	4	5	4
PCB 118	23	18	16	19	17
PCB 126		3	3	3	3
PCB 128	5	3	5	5	4
PCB 138	50	29	27	28	28
PCB 153	43	39	34	36	36
PCB 170	2	1	1	1	1
PCB 180	4	5	3	4	4
PCB 187	11	11	9	10	10
PCB 195		ZR	ZR	ZR	
PCB 206		ZR	ZR	ZR	
PCB 209		ZR	ZR	ZR	

NIST did not report PCB concentration by degree of chlorination.

NOTE: PCB 8, PCB 44 and PCB 126 quantitation questionable. PCB 77 identification questionable, probably PCB 110.
 Z R - Zero or below detection limit. N R - Not reported.

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)
(cont.)

BATTELLE		Date (1987)	4/27	4/27	4/27	11/19	11/19	Mean (n=5)
		89	90	90	NR	NR	ZR	
PCB 8		NR	NR	NR	ZR	ZR	ZR	2
PCB 18	5	2	2	2	2	3	3	
PCB 28	5	NR	NR	NR	ZR	ZR	ZR	
PCB 44	6	5	8	10	4	4	4	6
PCB 52	7	4	4	6	4	2	2	4
PCB 66	12	4	4	6	12	12	12	8
PCB 77	29	23	20	44	NR	NR	NR	29
PCB 101	18	15	15	20	12	11	11	14
PCB 105	8	8	9	13	ZR	ZR	ZR	10
PCB 118	23	19	17	29	22	19	19	21
PCB 126		2	2	2	NR	NR	NR	
PCB 128	5	5	5	7	3	5	5	5
PCB 138	50	17	15	22	34	28	28	43
PCB 153	4.3	21	16	31	35	32	32	54
PCB 170	2	1	1	3	ZR	ZR	ZR	1
PCB 180	4	2	2	3	2	2	2	3
PCB 187	11	6	4	9	10	10	10	8
PCB 195		ZR	1	1	ZR	ZR	ZR	1
PCB 206		NR	NR	NR	ZR	ZR	ZR	
PCB 209		NR	NR	NR	ZR	ZR	ZR	

NOTE: PCB 77 identification questionable, probably PCB 110.
ZR - Zero or below detection limit. NR - Not reported.

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)
 (cont.)

BATTELLE		Date (1987)	4/27	4/27	4/27	11/19	11/19	Mean (n=5)
Degree of chlorination	Consensus value							
Dichlorobiphenyls	ZR	ZR	ZR	ZR	ZR	ZR	ZR	3
Trichlorobiphenyls	16	5	2	2	1	2	2	3
Tetrachlorobiphenyls	56	63	55	71	50	40	40	56
Pentachlorobiphenyls	100	82	78	120	83	71	71	86
Hexachlorobiphenyls	110	39	47	60	92	84	84	64
Heptachlorobiphenyls	26	18	20	27	27	28	28	24
Octachlorobiphenyls	6	1	1	1	1	1	1	1
Nonachlorobiphenyls	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
Total PCBs	320	210	200	280	260	230	230	

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)
(cont.)

NAF	Date (1987)	6/18 90	6/18 90	6/18 90	12/1 NR	12/1 NR	12/1 NR	Mean (n=7)
Compound		Consensus value						
PCB 8		5	ZR	ZR	ZR	ZR	NR	NR
PCB 18		5	ZR	ZR	ZR	ZR	9	5
PCB 28		5	6	7	6	9	15	11
PCB 44		6	5	5	6	10	6	7
PCB 52		7	6	6	7	9	6	8
PCB 66		12	ZR	ZR	ZR	ZR	NR	13
PCB 77		29	ZR	ZR	ZR	ZR	NR	8
PCB 101		18	18	17	19	29	17	7
PCB 105		8	8	6	7	20	11	10
PCB 118		23	23	21	24	42	22	28
PCB 126			ZR	ZR	ZR	ZR	NR	NR
PCB 128		5	5	5	4	8	4	2
PCB 138		50	35	32	35	63	34	3
PCB 153		43	50	47	51	66	38	42
PCB 170		2	ZR	ZR	ZR	3	5	52
PCB 180		4	3	3	3	5	4	4
PCB 187		11	11	10	11	16	10	12
PCB 195			ZR	ZR	ZR	ZR	ZR	15
PCB 206			ZR	ZR	ZR	ZR	ZR	12
PCB 209			ZR	ZR	ZR	ZR	2	3

Z R - Zero or below detection limit. N R - Not reported.

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)
(cont.)

NAF	Date (1987)	6/18	6/18	6/18	12/1	12/1	12/1	Mean (n=7)
Degree of chlorination	Consensus value							
Dichlorobiphenyls	5	ZR	ZR	ZR	NR	NR	NR	5
Trichlorobiphenyls	16	14	19	16	50	24	35	28
Tetrachlorobiphenyls	56	45	45	50	63	35	44	52
Pentachlorobiphenyls	100	110	110	120	170	99	120	130
Hexachlorobiphenyls	110	130	120	130	190	110	180	150
Heptachlorobiphenyls	26	21	20	21	38	24	34	27
Octachlorobiphenyls	6	3	3	4	ZR	ZR	ZR	3
Nonachlorobiphenyls		ZR	ZR	ZR	ZR	ZR	ZR	3
Total PCBs	320	330	320	340	510	290	420	390

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)
(cont..)

SAC	Date (1987) Water content (%)	6/2/3 89	6/2/3 91	6/2/4 90	10/1/5 89	10/2/0 90	10/2/0 89	Mean (n=6)
Compound	Consensus value							
PCB 8	ZR	5	9	9	6	NR	NR	8
PCB 18	ZR	5	21	19	21	NR	NR	20
PCB 28	ZR	5	10	8	8	NR	NR	9
PCB 44	ZR	6	12	19	16	NR	NR	17
PCB 52	ZR	7	24	18	22	NR	NR	21
PCB 66	ZR	12	56	43	57	NR	NR	52
PCB 77	ZR	29	18	36	28	40	NR	35
PCB 101	ZR	8	52	46	55	NR	NR	NR
PCB 105	ZR	23	52	46	55	NR	NR	51
PCB 118	ZR	50	52	52	52	NR	NR	NR
PCB 126	ZR	5	23	20	23	NR	NR	22
PCB 128	ZR	50	100	84	120	NR	NR	100
PCB 138	ZR	43	83	81	97	NR	NR	87
PCB 153	ZR	2	25	20	24	NR	NR	23
PCB 170	ZR	4	41	42	47	NR	NR	43
PCB 180	ZR	11	ZR	ZR	ZR	NR	NR	NR
PCB 187	ZR	ZR	110	ZR	NR	NR	NR	110
PCB 195	ZR	ZR	ZR	ZR	NR	NR	NR	NR
PCB 206	ZR	ZR	ZR	ZR	NR	NR	NR	NR
PCB 209	ZR	ZR	ZR	ZR	NR	NR	NR	NR

NOTE: PCB 77 identification questionable, probably PCB 110.
ZR - Zero or below detection limit. NR - Not reported.

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)
(cont.)

SAIC	Date (1987)	6/23	6/23	6/24	10/15	10/20	10/20	Mean (n=6)
Degree of chlorination	Consensus value							
Dichlorobiphenyls	NR	NR	NR	ZR	ZR	ZR	ZR	17
Trichlorobiphenyls	16	NR	NR	17	15	19	19	17
Tetrachlorobiphenyls	56	NR	NR	68	41	50	50	53
Pentachlorobiphenyls	100	NR	NR	86	48	59	59	64
Hexachlorobiphenyls	110	NR	NR	94	67	75	75	79
Heptachlorobiphenyls	26	NR	NR	37	16	26	26	26
Octachlorobiphenyls	6	NR	NR	17	ZR	8	8	12
Nonachlorobiphenyls		NR	NR	8	ZR	8	8	8
Total PCBs	320	NR	NR	330	190	240	250	

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)
(cont.)

SEFSC	Date (1987)	04/15		04/15		04/15		11/16		11/16		11/16		11/16		Mean (n=8)
		Water content (%)	90	90	90	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
Compound		Consensus value														
PCB 8		21	19	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	20
PCB 18	5	ZR	ZR	5	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	1	3
PCB 28	5	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	2	4
PCB 44	6	ZR	ZR	9	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	3	6
PCB 52	7	7	5	17	1	2	9	2	9	22	22	22	22	22	5	9
PCB 66	12	16	14	13	1	1	1	1	1	12	38	38	38	38	5	12
PCB 77	29	ZR	ZR	ZR	4	2	35	84	84	17	17	17	17	17	5	12
PCB 101	18	16	18	36	3	2	2	2	2	21	55	55	55	55	13	20
PCB 105	8	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR
PCB 118	23	23	11	41	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	22	24
PCB 126		ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR
PCB 128	5	5	8	9	1	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	4	9
PCB 138	50	75	79	240	9	5	57	160	160	160	160	160	160	160	32	82
PCB 153	43	49	12	100	6	3	50	110	110	110	110	110	110	110	36	46
PCB 170	2	ZR	ZR	140	7	2	30	75	75	75	75	75	75	75	38	48
PCB 180	4	4	7	6	1	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	6	4
PCB 187	11	12	14	23	1	1	12	25	25	25	25	25	25	25	8	12
PCB 195		ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	1	ZR
PCB 206	3	3	4	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	2	2
PCB 209	3	8	8	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	4	5

SEFSC did not report PCB concentration by degree of chlorination.

NOTE: PCB 77 identification questionable, probably PCB 110.
Z R - Zero or below detection limit. N R - Not reported.

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)
(cont.)

TAMU		Date (1987)	5/31	5/31	5/31	5/31	12/1	12/1
Compound	Water content (%)		89	89	89	89	NR	NR
PCB 8		ZR	ZR	ZR	ZR	ZR	ZR	ZR
PCB 18	5	ZR	ZR	ZR	ZR	ZR	ZR	ZR
PCB 28	5	2	3	3	3	1	4	1
PCB 44	6	2	2	3	2	2	2	ZR
PCB 52	7	5	5	4	4	5	7	9
PCB 66	12	5	4	4	4	8	8	3
PCB 77	29	34	33	33	30	NR	NR	NR
PCB 101	18	14	15	14	12	15	17	18
PCB 105	8	7	6	7	6	7	11	5
PCB 118	23	27	28	27	25	23	33	26
PCB 126		ZR	ZR	ZR	ZR	NR	NR	NR
PCB 128	5	4	5	5	5	3	7	5
PCB 138	50	50	49	48	45	35	56	40
PCB 153	43	63	60	60	56	44	66	49
PCB 170	2	1	2	1	2	ZR	ZR	ZR
PCB 180	4	4	3	4	4	1	4	4
PCB 187	11	14	13	15	14	7	16	12
PCB 195		ZR	ZR	ZR	ZR	ZR	ZR	ZR
PCB 206		ZR	ZR	ZR	ZR	ZR	ZR	ZR
PCB 209		1	1	1	1	ZR	ZR	ZR

NOTE: PCB 77 identification questionable, probably PCB 110.
ZR - Zero or below detection limit. NR - Not reported.

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)
(cont.)

TAMU	Date (1987)	12/1 NR	12/1 NR	12/1 NR	12/1 NR	12/1 NR	Mean (n=13)
Compound							
PCB 8	ZR	ZR	ZR	ZR	ZR	ZR	
PCB 18	ZR	ZR	ZR	ZR	ZR	ZR	2
PCB 28	2	2	2	1	2	2	2
PCB 44	4	2	4	2	3	1	2
PCB 52	7	4	4	ZR	5	7	5
PCB 66	6	3	9	7	13	3	6
PCB 77	NR	NR	NR	NR	NR	NR	
PCB 101	18	13	14	19	18	33	17
PCB 105	8	5	10	4	9	5	7
PCB 118	21	28	31	21	31	25	27
PCB 126	NR	NR	NR	NR	NR	NR	
PCB 128	4	5	8	4	5	4	5
PCB 138	39	44	50	25	48	36	43
PCB 153	45	47	64	38	57	50	54
PCB 170	ZR	ZR	ZR	ZR	ZR	ZR	1
PCB 180	4	2	4	2	3	2	3
PCB 187	12	11	14	8	13	11	12
PCB 195	ZR	ZR	ZR	ZR	ZR	ZR	
PCB 206	ZR	ZR	ZR	ZR	ZR	ZR	
PCB 209	ZR	ZR	ZR	ZR	ZR	ZR	

Z R - Zero or below detection limit. N R - Not reported.

Table III.5. 1987 Polychlorinated biphenyls in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)
(cont.)

TAMU		Date (1987)	Consensus value	5/31	5/31	5/31	5/31	12/1	12/1	12/1
Degree of chlorination										
Dichlorobiphenyls	ZR									
Trichlorobiphenyls	1.6	8	ZR							
Tetrachlorobiphenyls	5.6	27	10	ZR						
Pentachlorobiphenyls	100	120	27	9	ZR					
Hexachlorobiphenyls	110	150	120	26	25	ZR				
Heptachlorobiphenyls	26	27	150	120	120	2	ZR			
Octachlorobiphenyls	6	2	150	140	140	4	ZR			
Nonachlorobiphenyls	ZR	ZR	26	28	26	14	ZR			
Total PCBs	320	340	340	340	320	320	300	370	370	300
Date (1987)	12/1	12/1	12/1	12/1	12/1	12/1	12/1	Mean (n=13)		
Degree of chlorination										
Dichlorobiphenyls	ZR	ZR	ZR	ZR	ZR	ZR	ZR			
Trichlorobiphenyls	1.5	3	3	12	5	20	20			
Tetrachlorobiphenyls	4.2	20	98	41	4.5	18	18			
Pentachlorobiphenyls	100	110	100	130	100	130	130			
Hexachlorobiphenyls	120	140	180	95	150	110	110			
Heptachlorobiphenyls	29	17	36	12	36	14	14			
Octachlorobiphenyls	4	ZR	ZR	ZR	ZR	ZR	ZR			
Nonachlorobiphenyls	ZR	ZR	ZR	ZR	ZR	ZR	ZR			
Total PCBs	300	260	420	290	320	260	260			

Table III.6. 1987 Pesticides in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted)

NIST	Date (1987) Water content (%)	7/7 87	7/7 87	7/7 87	Mean (n=3)
Compound	Consensus value				
2,4'-DDD	4	1	1	1	1
2,4'-DDE	3	1	ZR	1	1
2,4'-DDT	4	2	2	2	2
4,4'-DDD	8	3	4	4	4
4,4'-DDE	16	27	30	30	29
4,4'-DDT	6	2	2	2	2
Aldrin	3	3	1	1	2
cis-Chlordane	6	3	3	3	3
Dieldrin	8	4	4	5	4
gamma-HCH	3	1	ZR	ZR	
Heptachlor	1	ZR	ZR	ZR	
Heptachlor epoxide	2	3	ZR	3	2
Hexachlorobenzene	1	2	2	2	2
Mirex	1	1	1	1	1
trans-Nonachlor	5	3	3	3	3

Z R - Zero or below detection limit. N R - Not reported.

Table III.6. 1987 Pesticides in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

BATTELLE							Mean (n=5)
Date (1987)	Water content (%)	4/27	4/27	4/27	11/16	11/16	
Compound		Consensus value			NR	NR	NR
2,4'-DDD	4	NR	NR	NR	ZR	1	1
2,4'-DDE	3	NR	NR	NR	2	2	2
2,4'-DDT	4	NR	NR	NR	3	4	9
4,4'-DDD	8	8	12	13	6	4	9
4,4'-DDDE	16	8	9	12	16	13	13
4,4'-DDE	6	13	18	13	3	3	10
4,4'-DDT	3	NR	NR	NR	ZR	ZR	
Aldrin	6	14	8	17	3	2	9
cis-Chlordane	8	8	9	11	6	5	8
Dieldrin	3	4	5	5	ZR	ZR	5
gamma-HCH	1	1	1	NR	ZR	ZR	1
Heptachlor	2	NR	NR	NR	2	1	1
Heptachlor epoxide	1	1	1	ZR	ZR	ZR	
Hexachlorobenzene	1	NR	NR	NR	ZR	ZR	
Mirex	5	3	5	5	4	4	4
trans-Nonachlor							

Z R - Zero or below detection limit. NR - Not reported.

Table III.6. 1987 Pesticides in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

NAF	Date (†987)	Water content (%)	6/18 90	6/18 90	6/18 90	12/1 NR	12/1 NR	12/1 NR	Mean (n=7)
Compound	Consensus value								
2,4'-DDD	4	3	3	ZR	6	4	4	5	4
2,4'-DDE	3	4	3	ZR	ZR	ZR	ZR	ZR	4
2,4'-DDT	4	3	3	ZR	NR	NR	NR	NR	3
4,4'-DDD	8	5	4	5	13	9	5	11	7
4,4'-DDDE	16	18	16	17	23	14	17	18	14
4,4'-DDE	6	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
4,4'-DDT	6	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
cis-Chlordane	3	4	4	5	6	4	5	4	5
Aldrin	6	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
Dieldrin	8	6	6	6	10	6	7	9	7
gamma-HCH	3	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
Heptachlor	1	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
Heptachlor epoxide	2	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
Hexachlorobenzene	1	1	1	1	2	ZR	ZR	ZR	1
Mirex	1	ZR	ZR	ZR	ZR	ZR	ZR	ZR	2
trans-Nonachlor	5	4	4	4	6	4	5	5	5

Z R - Zero or below detection limit. N R - Not reported.

Table III.6. 1987 Pesticides in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

S A I C	Date (1987)	Water content (%)	6/2/3 89	6/2/3 91	6/24 90	10/15 89	10/18 93	10/20 90	10/20 89	Mean (n=7)
Compound	Consensus value									
2,4'-DDD	4	9	5	5	11	ZR	ZR	ZR	ZR	9
2,4'-DDE	3	ZR	ZR	ZR	12	ZR	ZR	ZR	ZR	8
2,4'-DDT	4	8	5	11	14	ZR	5	ZR	ZR	10
4,4'-DDD	8	16	24	33	11	ZR	7	ZR	ZR	20
4,4'-DDE	16	34	24	14	6	ZR	ZR	ZR	ZR	12
4,4'-DDT	6	16	12	11	ZR	ZR	ZR	ZR	ZR	9
cis-Chlordane	3	13	7	ZR	6	ZR	5	ZR	ZR	6
Aldrin	6	ZR	ZR	ZR	13	14	10	7	7	10
Dieldrin	8	12	9	ZR	2	ZR	ZR	ZR	ZR	2
gamma-HCH	3	3	2	1	2	ZR	ZR	ZR	ZR	2
Heptachlor	1	2	ZR	ZR	ZR	ZR	ZR	ZR	ZR	2
Heptachlor epoxide	2	3	2	2	ZR	ZR	ZR	ZR	ZR	2
Hexachlorobenzene	1	ZR	ZR	ZR	6	ZR	ZR	ZR	ZR	1
Mirex	1	ZR	ZR	ZR	4	ZR	ZR	ZR	ZR	6
trans-Nonachlor	5	13	8	11	ZR	4	ZR	ZR	ZR	4

Z R - Zero or below detection limit. N R - Not reported.

Table III.6. 1987 Pesticides in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

SEFSC	Date (1987)	Water content (%)	4/15 90	4/15 90	4/15 90	11/16 NR	11/16 NR	11/16 NR	11/16 NR	Mean (n=8)
Compound		Consensus value								
2,4'-DDD	4	ZR	ZR	5	1	ZR	ZR	2	6	3
2,4'-DDE	3	3	6	ZR	ZR	ZR	ZR	ZR	ZR	5
2,4'-DDT	4	5	ZR	ZR	ZR	ZR	ZR	ZR	ZR	5
4,4'-DDD	8	19	22	6	1	ZR	6	17	4	11
4,4'-DDDE	16	16	13	13	2	1	17	38	13	14
4,4'-DDE	6	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
4,4'-DDT	6	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
cis-Chlordane	3	5	ZR	7	1	ZR	6	16	4	6
Aldrin	6	ZR	ZR	ZR	ZR	ZR	31	ZR	ZR	31
Dieldrin	8	13	11	6	1	ZR	6	14	4	7
gamma-HCH	3	14	11	3	ZR	ZR	ZR	ZR	ZR	1
Heptachlor	1	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
Heptachlor epoxide	2	ZR	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
Hexachlorobenzene	1	1	ZR	1	ZR	ZR	ZR	ZR	ZR	1
Mirex	1	2	ZR	ZR	ZR	ZR	ZR	ZR	ZR	2
trans-Nonachlor	5	4	5	5	1	ZR	6	16	3	5

Z R - Zero or below detection limit. N R - Not reported.

Table III.6. 1987 Pesticides in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

TAMU		Compound	Consensus value	5/30		5/30		5/30		11/30		11/30	
Date (1987)	Water content (%)			89	89	89	89	NR	NR	NR	NR	NR	NR
2,4'-DDD	4	2	2					2	2	2	2	2	2
2,4'-DDE	3	ZR	ZR					ZR	ZR	ZR	ZR	ZR	ZR
2,4'-DDT	4	1	1					1	1	1	1	1	1
4,4'-DDD	8	7	7					6	6	4	9	8	8
4,4'-DDE	16	15	14					14	12	12	13	13	13
4,4'-DDT	6	2	2					ZR	ZR	ZR	ZR	ZR	ZR
Aldrin	3	ZR	ZR					ZR	ZR	ZR	ZR	ZR	ZR
cis-Chlordane	6	5	5					5	4	5	6	5	5
Dieldrin	8	8	7					7	7	8	7	6	6
gamma-HCH	3	ZR	ZR					1	1	ZR	ZR	ZR	ZR
Heptachlor	1	ZR	ZR					ZR	ZR	ZR	ZR	ZR	ZR
Heptachlor epoxide	2	ZR	ZR					ZR	ZR	ZR	ZR	ZR	ZR
Hexachlorobenzene	1	ZR	ZR					ZR	ZR	ZR	ZR	ZR	ZR
Mirex	1	ZR	ZR					ZR	ZR	ZR	ZR	ZR	ZR
trans-Nonachlor	5	5	4					4	4	4	5	4	4

Z R - Zero or below detection limit. N R - Not reported.

Table III.6. 1987 Pesticides in mussel tissue (Ti87) intercomparison exercise results (ng/g dry weight unless noted) (cont.)

TAMU	Date (1987) Water content (%)	11/30 NR	11/30 NR	11/30 NR	11/30 NR	11/30 NR	Mean (n=13)
Compound							
2,4'-DDD	2	2	2	1	ZR	ZR	2
2,4'-DDE	ZR	ZR	ZR	ZR	ZR	ZR	1
2,4'-DDT	ZR	3	ZR	2	ZR	ZR	1
4,4'-DDD	6	7	8	6	5	3	6
4,4'-DDE	11	12	15	11	15	12	13
4,4'-DDT	ZR	3	ZR	1	ZR	ZR	2
Aldrin	ZR	ZR	3	ZR	4	ZR	1
cis-Chlordane	5	3	7	5	6	6	5
Dieldrin	5	7	7	4	8	4	7
gamma-HCH	ZR	ZR	ZR	1	ZR	ZR	1
Heptachlor	ZR	ZR	ZR	ZR	ZR	ZR	ZR
Heptachlor epoxide	ZR	ZR	ZR	ZR	ZR	ZR	ZR
Hexachlorobenzene	ZR	ZR	ZR	ZR	ZR	ZR	ZR
Mirex	ZR	ZR	ZR	ZR	ZR	ZR	ZR
trans-Nonachlor	3	3	4	4	5	3	4

APPENDIX IV

1988 TRACE ORGANIC INTERCOMPARISON EXERCISE MATERIALS AND RESULTS

NIST: National Institute of Standards and Technology
BATTELLE: Battelle Ocean Sciences
NAF: NOAA/NMFS/Northwest Fisheries Science Center
TAMU: Texas A&M University

Table IV.1. 1988 Polycyclic aromatic hydrocarbons in hexane and toluene [QA88S1AH (VAR-PAH)] composition and intercomparison exercise results ($\mu\text{g/mL}$ unless noted)

Compound	($\mu\text{g/g}$)	($\mu\text{g/mL}$ at 20°C)	Compound	($\mu\text{g/g}$)	($\mu\text{g/mL}$ at 20°C)
1-Methylnaphthalene	3.99	2.64	Benz[<i>k</i>]fluoranthene	4.26	2.82
1-Methylphenanthrene	5.33	3.53	Benz[<i>a</i>]anthracene	5.16	3.41
1,6,7-Trimethylnaphthalene	1.55	1.02	Biphenyl	1.54	1.02
2,6-Dimethylnaphthalene	2.12	1.40	Chrysene	36.6	24.2
2-Methylnaphthalene	2.99	1.98	Dibenz[<i>a,h</i>]anthracene	7.60	5.03
Acenaphthene	1.67	1.10	Fluoranthene	25.2	16.7
Acenaphthylene	2.18	1.44	Fluorene	2.49	1.64
Anthracene	3.31	2.19	Indeno[1,2,3- <i>cd</i>]pyrene	3.56	2.35
Benzo[<i>a</i>]pyrene	5.73	3.79	Naphthalene	4.70	3.11
Benzo[<i>b</i>]fluoranthene	4.17	2.76	Perylene	6.42	4.25
Benzo[<i>e</i>]pyrene	1.87	1.24	Phenanthrene	31.7	21.0
Benzo[<i>gh</i>]perylene	4.25	2.81	Pyrene	23.8	15.7

Within Sample S1: Three gas chromatographic (GC) replicates of sample 1 (S1).

Mean Absolute %Error: Accuracy indicator. The mean of the absolute percent errors of the three sample 1 replicates, S1-A, S1-B and S1-C, relative to the NIST gravimetric value.

S1 %RSD: Precision indicator. The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.

S1 Mean: The mean value of the reported S1 replicates, S1-A, S1-B and S1-C.

Between Samples S1, S2, S3: Three independent sample preparations.

Mean Absolute %Error: The mean of the absolute percent errors of the S1 mean and the reported samples, S2 and S3 relative to the NIST gravimetric value.

S1-3 %RSD: The percent relative standard deviation of the S1 mean and the reported samples, S2 and S3.

S1-3 Mean: The mean concentration of the laboratory's reported concentrations for the three samples, S1, S2 and S3, in which the mean value of the three GC replicates was used for the S1 concentration.

Table IV.1. 1988 Polycyclic aromatic hydrocarbons in hexane and toluene [QA88S1AH (VAR-PAH)] composition and intercomparison exercise results (µg/mL unless noted) (cont.)

NIST Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A			S1-B			S1-C			S2		
		Mean	%Error	%RSD	Mean	%Error	%RSD	Mean	%Error	%RSD	Mean	%Error	%RSD
1-Methylnaphthalene	2.6	2.4	2.3	11.1	0.7	2.3	2.4	2.4	10.8	0.3	2.4	0.3	2.4
1-Methylphenanthrene	3.5	3.5	3.5	0.4	0.3	3.5	3.5	3.5	0.5	0.6	3.5	0.6	3.5
1,6,7-Trimethylnaphthalene	1.0	1.0	1.0	1.3	1.3	1.0	1.0	1.0	0.9	1.3	1.0	1.3	1.0
2,6-Dimethylnaphthalene	1.4	1.3	1.3	5.3	0.8	1.3	1.3	1.3	4.5	0.8	1.3	0.8	1.3
2-Methylnaphthalene	2.0	1.9	2.0	1.9	2.1	0.7	1.9	1.9	1.9	2.5	0.8	1.9	1.9
Acenaphthene	1.1	1.1	1.1	1.0	0.3	1.1	1.1	1.1	1.1	0.9	0.3	1.1	1.1
Acenaphthylene	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.7	0.5	1.4	1.4
Anthracene	2.2	2.2	2.2	2.2	2.3	0.5	2.2	2.2	2.2	2.2	1.9	0.6	2.2
Benzol[a]pyrene	3.8	3.8	3.8	3.8	0.5	0.1	3.8	3.8	3.8	0.2	0.3	3.8	3.8
Benzol[b]fluoranthene	2.8	2.8	2.8	2.8	2.6	0.4	2.8	2.8	2.8	2.1	0.6	2.8	2.8
Benzol[e]pyrene	1.2	1.2	1.2	1.2	4.1	1.2	1.2	1.2	1.2	2.4	1.6	1.2	1.2
Benzol[gh]perylene	2.8	2.8	2.8	2.8	1.0	0.4	2.8	2.8	2.8	0.6	0.4	2.8	2.8
Benzol[k]fluoranthene	2.8	2.8	2.8	2.8	0.3	0.4	2.8	2.8	2.8	0.3	0.5	2.8	2.8
Benz[a]anthracene	3.4	3.4	3.4	3.4	0.3	0.4	3.4	3.4	3.4	0.2	0.2	3.4	3.4
Biphenyl	1.0	1.0	1.0	1.0	1.5	1.0	1.0	1.0	1.0	0.9	1.4	1.0	1.0
Chrysene	24.2	24.1	24.1	24.2	0.2	0.2	24.2	24.2	24.2	24.1	0.2	0.1	24.2
Dibenz[a,h]anthracene	5.0	5.0	5.0	0.4	0.4	5.0	5.0	5.0	5.0	0.2	0.4	5.0	5.0
Fluoranthene	16.7	16.8	16.8	16.8	0.5	0.2	16.8	16.8	16.8	16.7	0.3	0.5	16.7
Fluorene	1.6	1.6	1.6	1.6	0.4	0.6	1.6	1.6	1.6	1.7	0.6	1.0	1.6
Indeno[1,2,3-cd]pyrene	2.4	2.4	2.4	2.4	1.2	0.4	2.4	2.4	2.4	2.4	1.0	0.6	2.4
Naphthalene	3.1	3.1	3.1	0.4	0.6	3.1	3.2	3.2	3.2	1.3	0.8	3.1	3.1
Perylene	4.3	4.3	4.2	4.2	0.3	0.3	4.2	4.3	4.3	4.2	0.3	0.3	4.2
Phenanthrene	21.0	21.2	21.1	0.6	0.3	21.1	21.1	21.1	21.1	0.4	0.2	21.1	21.1
Pyrene	15.7	15.6	15.6	15.6	0.7	0.2	15.6	15.6	15.6	0.7	0.2	15.6	15.6

Table IV.1. 1988 Polycyclic aromatic hydrocarbons in hexane and toluene [QA88S1AH (VAR-PAH)] composition and intercomparison exercise results ($\mu\text{g}/\text{mL}$ unless noted) (cont.)

BATTELLE

Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A		S1-B		S1-C	S1	S1	S2	S3	S1-3	S1-3	S1-3
		%Error	%RSD	%Error	%RSD	Mean	Mean	%Error	%RSD	Mean	%Error	%RSD	Mean
1-Methylnaphthalene	2.6	2.8	2.7	3.5	1.7	2.7	2.6	2.7	2.4	2.2	2.2	2.7	2.7
1-Methylphenanthrene	3.5	3.8	3.6	3.9	6.8	3.3	3.8	3.7	3.5	4.2	3.2	3.7	3.7
1,6,7-Trimethylnaphthalene	1.0	0.9	0.8	0.8	18.2	5.6	0.8	0.8	0.8	18.6	0.9	0.8	0.8
2,6-Dimethylnaphthalene	1.4	1.2	1.3	1.2	12.1	3.8	1.2	1.2	1.2	13.6	1.1	1.2	1.2
2-Methylnaphthalene	2.0	1.7	1.7	1.7	13.9	0.0	1.7	1.6	1.7	15.6	2.4	1.7	1.7
Acenaphthene	1.1	1.0	1.0	1.0	10.4	1.9	1.0	1.0	1.0	10.5	1.1	1.0	1.0
Acenaphthylene	1.4	1.3	1.3	1.2	12.0	3.7	1.3	1.3	1.2	12.8	2.9	1.3	1.3
Anthracene	2.2	2.3	2.1	2.1	4.4	4.4	2.2	2.2	2.0	3.4	4.0	2.1	2.1
Benzol[a]pyrene	3.8	3.7	3.8	3.9	1.8	2.2	3.8	3.9	3.7	1.8	2.2	3.8	3.8
Benzol[b]fluoranthene	2.8	2.7	2.7	3.1	5.5	6.7	2.8	2.8	2.8	2.0	0.6	2.8	2.8
Benzol[e]pyrene	1.2	1.1	1.2	1.1	8.3	4.2	1.1	1.1	1.1	7.4	3.4	1.1	1.1
Benzol[ghi]perylene	2.8	2.6	2.6	2.8	5.2	3.5	2.7	2.7	2.6	5.6	1.5	2.7	2.7
Benzol[k]fluoranthene	2.8	3.0	3.0	3.1	7.6	1.6	3.0	3.2	3.1	10.4	2.4	3.1	3.1
Benz[a]anthracene	3.4	3.5	3.5	3.9	6.4	5.2	3.6	3.6	3.5	4.8	1.7	3.6	3.6
Biphenyl	1.0	1.0	0.9	0.9	7.4	2.2	0.9	0.9	0.9	8.9	1.9	0.9	0.9
Chrysene	24.2	27.0	28.0	31.0	18.6	5.9	28.7	29.0	29.0	19.5	0.7	28.9	28.9
Dibenz[a,h]anthracene	5.0	6.2	6.2	6.6	26.0	3.0	6.3	6.4	6.2	25.6	1.7	6.3	6.3
Fluoranthene	16.7	20.0	17.0	20.0	13.8	7.4	19.0	20.0	19.0	15.8	2.8	19.3	19.3
Fluorene	1.6	1.5	1.5	1.5	8.8	0.0	1.5	1.5	1.5	8.8	0.0	1.5	1.5
Indeno[1,2,3-cd]pyrene	2.4	1.8	2.0	1.9	19.3	4.3	1.9	1.8	2.1	17.9	5.3	1.9	1.9
Naphthalene	3.1	3.0	3.0	3.1	2.4	1.6	3.0	3.0	3.1	2.0	1.3	3.0	3.0
Perylene	4.3	4.4	4.6	4.5	5.9	1.8	4.5	4.6	4.4	5.9	1.9	4.5	4.5
Phenanthrene	21.0	24.0	22.0	25.0	12.8	5.3	23.7	24.0	22.0	10.7	4.2	23.2	23.2
Pyrene	15.7	19.0	17.0	19.0	16.6	5.1	18.3	18.0	18.0	15.2	1.0	18.1	18.1

Table IV.1. 1988 Polycyclic aromatic hydrocarbons in hexane and toluene [QA88S1AH (VAR-PAH)] composition and intercomparison exercise results (µg/mL unless noted) (cont.)

NAF	Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
			S1-A			S1-B	S1-C	S1	S1	S2	S3	S1-3	S1-3	S1-3
			Mean	%Error	%RSD	Mean	%Error	Mean	%Error	%RSD	Mean	%Error	%RSD	Mean
	1-Methylnaphthalene	2.6	2.8	2.5	2.7	3.8	4.5	2.6	2.4	2.6	3.2	3.6	2.6	2.6
	1-Methylphenanthrene	3.5	3.4	2.9	3.7	8.3	9.3	3.3	3.2	3.5	5.1	2.6	3.4	3.4
	1,6,7-Trimethylnaphthalene	1.0	0.8	0.9	0.9	15.0	5.0	0.9	0.8	0.8	20.0	4.5	0.8	0.8
	2,6-Dimethylnaphthalene	1.4	1.2	1.2	1.4	11.2	6.1	1.3	1.2	1.3	12.1	3.4	1.2	1.2
	2-Methylnaphthalene	2.0	1.8	1.6	1.5	17.8	6.7	1.6	1.6	1.7	18.3	1.8	1.6	1.6
	Acenaphthene	1.1	1.0	0.9	1.1	10.1	7.7	1.0	1.0	1.0	11.3	1.2	1.0	1.0
	Acenaphthylene	1.4	1.3	1.2	1.5	9.7	9.3	1.4	1.3	1.4	8.1	3.9	1.3	1.3
	Anthracene	2.2	2.0	1.8	2.2	8.4	7.3	2.0	2.0	2.1	7.0	3.4	2.0	2.0
	Benzol[a]pyrene	3.8	3.7	3.4	3.6	5.7	3.8	3.6	3.7	3.8	2.6	2.5	3.7	3.7
	Benzol[b]fluoranthene	2.8	2.7	2.5	2.7	5.1	2.6	2.6	2.4	2.4	10.1	3.6	2.5	2.5
	Benzol[e]pyrene	1.2	1.0	1.0	1.1	16.8	3.4	1.0	1.1	1.0	15.0	2.8	1.1	1.1
	Benzol[gh]perylene	2.8	2.6	2.6	2.6	8.2	0.6	2.6	2.6	2.7	6.7	2.1	2.6	2.6
	Benzol[k]fluoranthene	2.8												
	Benz[a]anthracene	3.4	3.5	3.4	3.5	2.6	2.2	3.5	3.3	3.4	2.1	2.5	3.4	3.4
	Biphenyl	1.0	0.9	0.9	1.0	8.8	6.5	0.9	0.9	1.0	8.3	0.8	0.9	0.9
	Chrysene	24.2	26.5	24.9	26.0	6.8	2.6	25.8	26.3	26.0	7.6	0.8	26.0	26.0
	Dibenz[a,h]anthracene	5.0	4.6	4.6	4.6	8.5	0.6	4.6	5.0	5.0	3.2	3.8	4.9	4.9
	Fluoranthene	16.7	17.5	15.3	19.4	9.9	9.8	17.4	17.8	19.7	9.7	6.1	18.3	18.3
	Fluorene	1.6	1.5	1.4	1.6	8.8	7.0	1.5	1.4	1.5	9.6	3.1	1.5	1.5
	Indeno[1,2,3-cd]pyrene	2.4	2.0	2.1	2.0	15.6	2.2	2.0	2.1	2.1	12.6	2.2	2.1	2.1
	Naphthalene	3.1	3.3	3.0	3.3	5.0	4.7	3.2	2.9	3.2	4.0	4.5	3.1	3.1
	Perylene	4.3	4.4	3.8	4.2	4.5	5.4	4.1	4.3	4.4	2.4	2.6	4.3	4.3
	Phenanthrene	21.0	21.5	19.6	23.9	7.6	8.1	21.7	21.8	22.2	4.4	1.2	21.9	21.9
	Pyrene	15.7	16.3	14.9	18.8	9.7	9.8	16.7	17.1	18.1	10.0	3.9	17.3	17.3

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Table IV.1. 1988 Polycyclic aromatic hydrocarbons in hexane and toluene [QA88S1AH (VAR-PAH)] composition and intercomparison exercise results ($\mu\text{g/mL}$ unless noted) (cont.)

Compound	NST Assigned	Within Sample - S1						Between Samples - S1, S2, S3								
		S1-A		S1-B		S1-C	Mean	S1		S2		S3		Mean	%Error	%RSD
		%Error	%RSD	%Error	%RSD	Mean	%RSD	Mean	%RSD	Mean	%RSD	Mean	%RSD	Mean	%RSD	Mean
1-Methylnaphthalene	2.6	2.7	2.6	2.6	1.5	1.5	2.6	2.6	2.6	1.2	0.8	2.6	0.8	2.6	0.8	2.6
1-Methylphenanthrene	3.5	3.6	3.4	3.5	1.7	1.5	3.5	3.5	3.5	1.2	1.0	3.5	1.2	3.5	1.0	3.5
1,6,7-Trimethylnaphthalene	1.0	1.0	1.0	1.0	1.5	1.3	1.0	1.0	1.0	1.6	1.2	1.0	1.6	1.2	1.0	1.0
2,6-Dimethylnaphthalene	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
2-Methylnaphthalene	2.0	2.0	1.9	1.9	2.3	1.1	1.9	2.0	1.9	1.9	1.8	0.4	1.9	0.4	1.9	1.9
Acenaphthene	1.1	1.2	1.2	1.2	6.5	2.0	1.2	1.2	1.2	1.1	5.2	1.2	1.2	1.2	1.2	1.2
Acenaphthylene	1.4	1.5	1.5	1.5	4.0	0.9	1.5	1.5	1.5	1.5	2.3	1.4	1.5	2.3	1.4	1.5
Anthracene	2.2	2.5	2.2	2.5	9.7	4.9	2.4	2.3	2.3	2.4	8.2	1.6	2.4	8.2	1.6	2.4
Benz[a]pyrene	3.8	3.7	3.7	3.7	2.7	0.3	3.7	3.8	3.8	3.6	2.9	1.8	3.7	3.6	1.8	3.7
Benz[b]fluoranthene	2.8	2.9	2.8	2.7	2.4	2.0	2.8	2.7	2.7	2.6	3.0	3.0	2.7	3.0	3.0	2.7
Benz[e]pyrene	1.2	1.2	1.2	1.2	2.9	1.1	1.2	1.2	1.2	1.1	4.4	2.4	1.2	4.4	2.4	1.2
Benz[gh]perylene	2.8	2.6	2.6	2.6	7.2	0.5	2.6	2.9	2.6	2.6	5.8	4.8	2.7	5.8	4.8	2.7
Benz[k]fluoranthene	2.8	2.7	2.8	2.9	2.6	2.8	2.8	2.9	2.8	2.8	1.3	1.7	2.8	1.3	1.7	2.8
Benz[a]anthracene	3.4	3.3	3.4	3.4	1.3	1.4	3.4	3.4	3.4	3.3	2.0	1.1	3.4	2.0	1.1	3.4
Biphenyl	1.0	1.0	1.0	1.0	1.0	1.8	1.8	1.0	1.0	1.0	1.8	1.2	1.0	1.8	1.2	1.0
Chrysene	24.2	23.2	23.4	23.2	3.8	0.4	23.3	22.7	22.7	22.4	5.8	1.5	22.8	5.8	1.5	22.8
Dibenz[a,h]anthracene	5.0	4.7	4.5	4.6	8.2	1.7	4.6	5.1	4.7	5.1	4.1	4.8	4.1	4.1	4.8	4.1
Fluoranthene	16.7	16.6	15.8	16.2	2.9	2.1	16.2	16.5	16.5	16.1	2.6	1.1	16.3	2.6	1.1	16.3
Fluorene	1.6	1.7	1.7	1.7	3.6	1.9	1.7	1.7	1.7	1.7	2.8	1.9	1.7	2.8	1.9	1.7
Indeno[1,2,3-cd]pyrene	2.4	2.1	2.0	2.1	11.5	1.7	2.1	2.4	2.4	2.1	7.3	5.4	2.2	7.3	5.4	2.2
Naphthalene	3.1	3.2	3.2	3.2	3.4	0.3	3.2	3.2	3.2	3.2	2.8	0.4	3.2	2.8	0.4	3.2
Perylene	4.3	4.2	4.2	4.3	1.0	0.0	4.2	4.3	4.3	4.1	1.6	1.7	4.2	1.6	1.7	4.2
Phenanthrene	21.0	20.2	20.3	20.4	3.3	0.5	20.3	20.2	20.2	20.0	4.0	0.6	20.2	4.0	0.6	20.2
Pyrene	15.7	15.2	14.3	14.8	6.2	2.4	14.7	15.3	14.7	15.3	5.1	1.7	14.9	5.1	1.7	14.9

Table IV.2. 1988 Polychlorinated biphenyls in 2,2,4-trimethylpentane [QA88S1CB (VAR-PCB)] composition and intercomparison exercise results (ng/mL unless noted)

Gravimetric concentration of components of QA88S1CB (VAR-PCB) prepared by NIST				
Compound	(ng/g)	(ng/mL at 20°C)	Compound	(ng/mL at 20°C)
PCB 8	36.9	25.5	PCB 128	101
PCB 18	58.2	40.2	PCB 138	708
PCB 28	139	95.7	PCB 153	1080
PCB 44	60.8	42.0	PCB 170	137
PCB 52	264	183	PCB 180	339
PCB 66	206	142	PCB 187	418
PCB 101	479	331	PCB 195	24.0
PCB 105	174	120	PCB 206	47.0
PCB 118	560	387	PCB 209	34.9
				24.1

Within Sample S1: Three gas chromatographic (GC) replicates of sample 1 (S1).

Mean Absolute %Error: Accuracy indicator. The mean of the absolute percent errors of the three sample 1 replicates, S1-A, S1-B and S1-C, relative to the NIST gravimetric value.

S1 %RSD: Precision indicator. The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.

S1 Mean: The mean value of the reported S1 replicates, S1-A, S1-B and S1-C.

Between Samples S1, S2, S3: Three independent sample preparations.

Mean Absolute %Error: The mean of the absolute percent errors of the S1 mean and the reported samples, S2 and S3 relative to the NIST gravimetric value.

S1-3 %RSD: The percent relative standard deviation of the S1 mean and the reported samples, S2 and S3.

S1-3 Mean: The mean concentration of the laboratory's reported concentrations for the three samples, S1, S2 and S3, in which the mean value of the three GC replicates was used for the S1 concentration.

Table IV.2. 1988 Polychlorinated biphenyls in 2,2,4-trimethylpentane [QA88S1CB (VAR-PCB)] composition and intercomparison exercise results (ng/mL unless noted) (cont.)

Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A		S1-B	S1-C	Mean	%Error	S1		S2	S3	Mean	%RSD
		NIST	Assigned					Mean	%RSD	Mean	%Error	Mean	%RSD
PCB 8	25.5	22.9	25.8	25.7	4.1	5.5	24.8	26.8	25.5	2.6	3.2	25.7	
PCB 18	40.2	42.8	42.4	38.5	5.3	4.7	41.2	44.0	42.1	5.6	2.7	42.5	
PCB 28	96.2	95.3	94.7	94.0	1.7	0.6	94.7	93.1	96.4	1.7	1.4	94.7	
PCB 44	42.0	43.9	40.8	41.9	2.5	3.0	42.2	43.7	44.4	3.5	2.1	43.4	
PCB 52	183.	182.	180.	182.	0.6	0.4	182.	180.	184.	0.9	0.8	182.	
PCB 66	143.	143.	140.	143.	0.9	1.1	142.	145.	144.	0.9	0.8	143.	
PCB 101	331.	337.	333.	338.	1.5	0.6	336.	338.	335.	1.5	0.4	336.	
PCB 105	120.	120.	123.	124.	2.0	1.4	122.	124.	125.	3.0	0.9	124.	
PCB 118	387.	388.	386.	400.	1.3	1.6	392.	397.	406.	3.0	1.5	398.	
PCB 128	69.7	70.7	72.9	72.3	3.3	1.3	72.0	74.7	73.1	5.1	1.5	73.3	
PCB 138	708.	716.	701.	726.	1.6	1.4	714.	730.	732.	2.5	1.1	725.	
PCB 153	744.	727.	710.	741.	2.4	1.7	726.	737.	743.	1.2	1.0	736.	
PCB 170	94.5	95.6	95.4	98.4	2.0	1.4	96.5	95.6	96.9	1.9	0.6	96.3	
PCB 180	234.	239.	238.	245.	2.8	1.3	241.	243.	244.	3.5	0.5	243.	
PCB 187	288.	295.	293.	305.	3.3	1.8	298.	298.	300.	3.5	0.3	299.	
PCB 195	16.8	17.0	17.5	17.1	2.4	1.3	17.2	17.2	17.5	3.1	0.7	17.3	
PCB 206	32.5	33.5	33.7	33.9	3.7	0.5	33.7	34.2	33.9	4.4	0.6	33.9	
PCB 209	24.1	24.1	24.7	26.8	4.6	4.6	25.2	26.5	25.0	5.9	2.6	25.5	

Table IV.2. 1988 Polychlorinated biphenyls in 2,2,4-trimethylpentane [QA88S1CB (VAR-PCB)] composition and intercomparison exercise results (ng/ml unless noted) (cont.)

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Compound	NIST Assigned	Within Sample - S1				Between Samples - S1, S2, S3			
		S1-A		S1-B	S1-C	S1 Mean	S2	S3	S1-3 Mean
		%Error	%RSD	%Error	%RSD	%Error	%Error	%Error	%RSD
PCB 8	25.5	26.0	22.0	18.0	15.0	14.8	22.0	17.0	19.0
PCB 18	40.2	46.0	42.0	42.0	7.8	4.4	43.3	41.0	5.6
PCB 28	96.2	80.0	75.0	72.0	21.4	4.4	75.7	73.0	22.2
PCB 44	42.0	44.0	38.0	36.0	9.5	8.6	39.3	38.0	39.0
PCB 52	183	172.	166.	164.	8.4	2.0	167.	172.	167.
PCB 66	142	129.	111.	111.	17.9	7.3	117.	115.	123.
PCB 101	331	344.	320.	304.	5.1	5.1	323.	329.	340.
PCB 105	120	125.	120.	111.	3.9	4.9	119.	136.	138.
PCB 118	387	413.	359.	340.	8.7	8.3	371.	387.	433.
PCB 128	69.7	65.0	53.0	51.0	19.2	11.0	56.3	56.0	65.0
PCB 138	708	838.	718.	689.	7.5	8.6	749.	786.	865.
PCB 153	744	802.	717.	681.	6.6	6.9	733.	759.	822.
PCB 170	94.5	98.0	78.0	71.0	15.3	13.9	82.3	87.0	97.0
PCB 180	234	284.	231.	214.	10.4	12.3	243.	258.	299.
PCB 187	288	335.	286.	275.	7.2	8.7	299.	317.	350.
PCB 195	16.8	10.0	7.0	6.0	54.3	22.2	7.7	7.0	9.0
PCB 206	32.5	35.0	28.0	22.0	17.9	18.7	28.3	27.0	28.0
PCB 209	24.1	23.0	17.0	14.0	25.4	20.8	18.0	18.0	25.4

Table IV.2. 1988 Polychlorinated biphenyls in 2,2,4-trimethylpentane [QA88S1CB (VAR-PCB)] composition and intercomparison exercise results (ng/mL unless noted) (cont.)

NAF	Compound	NIST Assigned	Within Sample - S1			S1 Mean	%RSD	Between Samples - S1, S2, S3		
			S1-A	S1-B	S1-C			S2	S3	%Error
PCB 8	25.5	82.5	78.1	79.2	213.	2.3	79.9	88.7	97.1	247
PCB 18	40.2	63.3	58.5	58.0	49.1	4.0	60.0	56.8	57.6	44.5
PCB 28	96.2	102.	105.	103.	7.4	1.1	103.	102.	100.	5.6
PCB 44	42.0	47.6	50.1	51.1	18.1	2.9	49.6	47.4	46.4	13.9
PCB 52	183	181.	186.	183.	1.0	1.1	183.	181.	179.	1.2
PCB 66	142	142.	150.	146.	2.8	2.3	146.	141.	137.	2.4
PCB 101	331	292.	308.	301.	9.3	2.2	300.	292.	287.	11.5
PCB 105	120	111.	124.	115.	5.3	4.9	116.	110.	97.7	10.3
PCB 118	387	335.	364.	346.	9.9	3.4	348.	337.	317.	13.6
PCB 128	69.7	71.5	79.7	73.5	7.5	4.7	74.9	70.3	60.9	7.0
PCB 138	708	587.	638.	593.	14.3	3.8	606.	579.	530.	19.2
PCB 153	744	574.	624.	594.	19.7	3.4	598.	575.	543.	23.2
PCB 170	94.5	95.2	107.	97.9	5.9	5.1	100.	92.2	78.7	8.4
PCB 180	234	216.	243.	222.	5.6	5.1	227.	214.	187.	10.7
PCB 187	288	257.	282.	264.	7.2	3.9	268.	251.	231.	13.4
PCB 195	16.8	20.5	22.3	20.3	25.5	4.3	21.1	19.0	16.5	13.5
PCB 206	32.5	38.9	43.4	38.5	24.1	5.5	40.3	36.0	29.7	14.5
PCB 209	24.1	31.1	34.9	31.7	35.1	5.2	32.6	30.2	24.8	21.1

Table IV.2. 1988 Polychlorinated biphenyls in 2,2,4-trimethylpentane [QA88S1CB (VAR-PCB)] composition and intercomparison exercise results (ng/mL unless noted) (cont.)

Compound	NIST Assigned	Within Sample - S1			Between Samples - S1, S2, S3		
		S1-A	S1-B	S1-C	S2	S3	S1-3
		Mean	%Error	%RSD	Mean	%Error	%RSD
PCB 8	25.5	27.8	27.2	8.3	1.2	27.6	27.6
PCB 18	40.2	42.2	42.3	4.9	0.2	42.2	41.1
PCB 28	96.2	96.6	96	96.3	0.3	96.3	94.1
PCB 44	4.2	42.6	42.7	42.2	1.3	42.5	38.8
PCB 52	183	182	182	0.3	0.2	182	178
PCB 66	142	145	146	142	1.3	1.0	144
PCB 101	331	359	366	370	10.4	1.3	365
PCB 105	120	108	165	135	19.9	17.1	136
PCB 118	387	404	419	422	7.4	1.9	415
PCB 128	69.7	63.6	65.1	66.6	6.6	1.8	65.1
PCB 138	708	859	905	899	25.5	2.3	888
PCB 153	744	892	828	874	16.2	3.1	865
PCB 170	94.5	84	87.3	89.1	8.2	2.4	86.8
PCB 180	234	226	237	242	2.7	2.8	235
PCB 187	288	285	293	298	2.1	1.9	292
PCB 195	16.8	12.9	10.4	11.8	30.3	8.9	11.7
PCB 206	32.5	29.6	28.8	28.3	11.1	1.9	28.9
PCB 209	24.1	22.6	21.7	17.5	14.5	10.8	20.6

Table IV.3. 1988 Pesticides in hexane [QA88S1PE (VAR-PES)] composition and intercomparison exercise results (ng/mL unless noted)

Gravimetric concentration* of components of QA88S1PE (VAR-PES) prepared by NIST					
Compound	(ng/g)	(ng/mL at 20°C)	Compound	(ng/g)	(ng/mL at 20°C)
2,4'-DDD	61.8	40.5	Dieldrin	14.7	96.2
2,4'-DDE	55.4	36.4	gamma-HCH	25.6	16.8
2,4'-DDT	29.9	19.6	Heptachlor	17.3	11.3
4,4'-DDD	172	112	Heptachlor epoxide	49.0	32.1
4,4'-DDE	592	388	Hexachlorobenzene	33.5	22.0
4,4'-DDT	50.3	33.0	Mirex	29.3	19.2
Aldrin	52.5	34.4	trans-Nonachlor	79.0	51.8
cis-Chlordane	94.5	62.0			

Within Sample S1: Three gas chromatographic (GC) replicates of sample 1 (S1).

Mean Absolute %Error: Accuracy indicator. The mean of the absolute percent errors of the three sample 1 replicates, S1-A, S1-B and S1-C, relative to the NIST gravimetric value.

S1 %RSD: Precision indicator. The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.

S1 Mean: The mean value of the reported S1 replicates, S1-A, S1-B and S1-C.

Between Samples S1, S2, S3: Three independent sample preparations.

Mean Absolute %Error: The mean of the absolute percent errors of the S1 mean and the reported samples, S2 and S3 relative to the NIST gravimetric value.

S1-3 %RSD: The percent relative standard deviation of the S1 mean and the reported samples, S2 and S3.

S1-3 Mean: The mean concentration of the laboratory's reported concentrations for the three samples, S1, S2 and S3, in which the mean value of the three GC replicates was used for the S1 concentration.

Table IV.3. 1988 Pesticides in hexane [QA88S1PE (VAR-PES)] composition and intercomparison exercise results (ng/mL unless noted)
(cont.)

Compound	NIST Assigned	Within Sample - S1				Between Samples - S1, S2, S3			
		S1-A	S1-B	S1-C	Mean	S1	S2	S3	Mean
2,4'-DDD	40.5	42.2	43.3	42.7	5.4	1.0	42.7	41.6	43.2
2,4'-DDE	36.4	37.0	36.3	36.5	0.8	0.8	36.6	36.5	38.1
2,4'-DDT	19.6	20.3	20.3	20.4	3.6	0.1	20.3	19.9	21.8
4,4'-DDD	112.5	116	113.	116.	2.2	1.1	115.	114.	117.
4,4'-DDE	388.5	398.	400.	402.	3.0	0.5	400.	391.	395.
4,4'-DDT	33.0	32.3	32.1	31.9	2.8	0.5	32.1	31.9	33.2
Aldrin	34.4	35.8	34.4	34.7	1.7	1.8	35.0	35.5	36.1
cis-Chlordane	62.0	63.3	61.7	61.8	1.0	1.2	62.3	63.5	64.3
Dieldrin	96.2	99.1	100.	98.5	3.1	0.6	99.2	96.5	100.
gamma-HCH	16.8	16.9	18.2	16.5	3.6	4.2	17.2	17.2	18.4
Heptachlor	11.3	11.3	11.5	11.1	1.5	1.6	11.3	11.6	12.0
Heptachlor epoxide	32.1	32.5	32.6	32.4	1.1	0.2	32.5	32.1	33.7
Hexachlorobenzene	22.0	21.9	22.6	21.8	1.3	1.5	22.1	21.8	23.5
Mirex	19.2	19.9	20.2	19.2	2.9	2.0	19.8	21.1	20.3
trans-Nonachlor	51.9	52.7	51.8	51.6	0.8	0.9	52.0	52.8	53.8

Table IV.3. 1988 Pesticides in hexane [QA88S1PE (VAR-PES)] composition and intercomparison exercise results (ng/mL unless noted)
(cont.)

Compound	NIST Assigned	Within Sample - S1				Between Samples - S1, S2, S3			
		S1-A		S1-B	S1-C	S1 Mean	S2	S3	S1-3 Mean
		%Error	%RSD	%Error	%RSD	%Error	%RSD	%Error	%RSD
2,4'-DDD	40.5	18.0	28.0	47.3	22.1	21.3	19.0	23.0	47.9
2,4'-DDE	36.4	37.0	36.0	33.0	4.0	4.8	35.3	33.0	36.0
2,4'-DDT	19.6	14.0	12.0	11.0	37.2	10.1	12.3	10.0	41.7
4,4'-DDD	112.5	110.	96.0	85.0	13.8	10.5	97.0	94.0	105.
4,4'-DDE	388.5	445.	395.	367.	7.3	8.0	402.	432.	508.
4,4'-DDT	33.0	25.0	17.0	18.0	39.4	17.8	20.0	20.0	22.0
Aldrin	34.4	34.0	33.0	32.0	4.1	2.5	33.0	34.0	31.0
cis-Chlordane	62.0	59.0	62.0	54.0	5.9	5.7	58.3	56.0	59.0
Dieldrin	96.2	97.0	91.0	87.0	5.3	4.5	91.7	93.0	100.
gamma-HCH	16.8	22.0	22.0	30.9	0.0	22.0	22.0	21.0	28.9
Heptachlor	11.3	13.0	13.0	13.0	14.6	0.0	13.0	12.0	13.0
Heptachlor epoxide	32.1	33.0	31.0	31.0	3.3	3.0	31.7	32.0	33.0
Hexachlorobenzene	22.0	19.0	18.0	18.0	16.5	2.6	18.3	17.0	18.0
Mirex	19.2	20.0	15.0	14.0	17.7	16.1	16.3	14.0	17.0
trans-Nonachlor	51.9	39.0	46.0	39.0	20.3	8.0	41.3	40.0	42.0

Table IV.3. 1988 Pesticides in hexane [QA88S1PE (VAR-PES)] composition and intercomparison exercise results (ng/mL unless noted)
(cont.)

Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A		S1-B	S1-C	Mean	%Error	S1		S2	S3	Mean	%Error
		NIST	Assigned				%RSD	Mean	%RSD	S2	S3	Mean	%RSD
2,4'-DDD	40.5	39.1	43.4	40.1	3.9	4.5	40.9	40.2	36.3	4.0	5.1	39.1	
2,4'-DDE	36.4	33.9	36.8	34.9	4.0	3.5	35.2	34.4	31.7	7.2	4.5	33.8	
2,4'-DDT	19.6	17.0	18.7	16.9	10.7	4.7	17.5	16.3	14.3	18.3	8.4	16.0	
4,4'-DDD	112.5	110	130.	114.	6.5	7.3	118.	112.	90.7	8.3	10.9	107.	
4,4'-DDE	388.5	327	373.	348.	10.1	5.3	349.	346.	308.	13.9	5.6	334.	
4,4'-DDT	33.0	25.1	27.7	23.9	22.5	6.2	25.6	22.9	18.7	32.2	12.7	22.4	
Aldrin	34.4	37.4	38.3	36.5	8.6	1.9	37.4	37.5	37.0	8.4	0.5	37.3	
cis-Chlordane	62.0	57.1	62.8	59.6	4.4	3.9	59.8	57.9	52.9	8.3	5.2	56.9	
Dieldrin	96.2	84.0	97.7	89.1	7.2	6.2	90.3	87.5	74.3	12.7	8.3	84.0	
gamma-HCH	16.8	12.2	12.4	11.6	28.2	3.0	12.1	11.6	10.7	31.8	4.9	11.5	
Heptachlor	11.3	12.7	12.8	10.8	9.6	7.4	12.1	12.3	11.7	5.9	1.9	12.0	
Heptachlor epoxide	32.1	30.9	32.3	30.2	3.5	2.8	31.1	29.6	27.5	8.5	5.0	29.4	
Hexachlorobenzene	22.0	26.3	26.7	20.8	0.7	26.5	26.8	25.5	19.7	2.0	26.3		
Mirex	19.2	24.2	26.4	30.6	3.7	25.1	23.6	20.8	20.6	7.6	23.2		
trans-Nonachlor	51.9	49.6	54.5	51.6	3.3	3.9	51.9	50.2	45.9	4.9	5.1	49.3	

Table IV.3. 1988 Pesticides in hexane [QA88S1PE (VAR-PES)] composition and intercomparison exercise results (ng/mL unless noted)
(cont.)

Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A		S1-B	S1-C	Mean	%RSD	S1		S2	S3	Mean	%RSD
		%Error	%RSD					%Error	%Error	%Error	%Error	%RSD	
2,4'-DDD	40.5	35.0	35.3	35.1	13.2	0.3	35.2	34.9	35.3	13.3	0.5	35.1	
2,4'-DDE	36.4	32.8	33.1	32.6	9.8	0.6	32.8	33.1	33.3	9.1	0.6	33.1	
2,4'-DDT	19.6	16.9	17.2	17.1	13.2	0.5	17.1	17.3	18.2	10.8	2.8	17.5	
4,4'-DDD	112.5	107.	108.	110.	3.8	1.2	108.	107.	108.	4.2	0.5	108.	
4,4'-DDE	388.5	339.	343.	340.	12.3	0.5	341.	341.	338.	12.5	0.4	340.	
4,4'-DDT	33.0	25.6	26.5	25.8	21.3	1.4	26.0	27.0	28.0	18.2	3.1	27.0	
Aldrin	34.4	33.5	34.0	33.5	2.3	0.7	33.6	33.7	33.8	2.1	0.2	33.7	
cis-Chlordane	62.0	59.7	60.4	59.9	3.2	0.5	60.0	60.4	60.3	2.9	0.3	60.2	
Dieldrin	96.2	92.9	93.6	90.7	4.0	1.4	92.4	93.2	94.0	3.2	0.7	93.2	
gamma-HCH	16.8	19.1	19.2	19.2	14.1	0.3	19.2	19.0	19.4	14.2	1.0	19.2	
Heptachlor	11.3	11.8	12.1	11.9	5.2	0.8	11.9	12.2	12.4	7.5	1.6	12.2	
Heptachlor epoxide	32.1	29.9	30.3	29.8	6.6	0.8	30.0	29.9	30.1	6.6	0.3	30.0	
Hexachlorobenzene	22.0	21.5	21.5	21.4	2.2	0.2	21.5	21.6	21.5	2.0	0.1	21.5	
Mirex	19.2	16.1	16.3	16.1	15.7	0.6	16.2	16.7	16.8	13.8	1.6	16.5	
trans-Nonachlor	51.9	49.4	50.0	49.6	4.2	0.5	49.7	49.9	49.7	4.0	0.3	49.8	

APPENDIX V

1989 TRACE ORGANIC INTERCOMPARISON EXERCISE MATERIALS AND RESULTS

NIST: National Institute of Standards and Technology
BATTELLE: Battelle Ocean Sciences
NAF: NOAA/NMFS/Northwest Fisheries Science Center
TAMU: Texas A&M University

Table V.1. 1989 Polycyclic aromatic hydrocarbons in hexane and toluene [QA89S1AH (VAR2-PAH)] composition and intercomparison exercise results ($\mu\text{g/mL}$ unless noted)

Gravimetric concentration of components of QA89S1PE (VAR2-PAH) prepared by NIST					
Compound	($\mu\text{g/g}$)	($\mu\text{g/mL}$ at 20°C)	Compound	($\mu\text{g/g}$)	($\mu\text{g/mL}$ at 20°C)
1-Methylnaphthalene	4.9	3.2	Benz[<i>k</i>]fluoranthene	9.5	6.3
1-Methylphenanthrene	5.6	3.7	Benz[a]anthracene	10.0	6.6
1,6,7-Trimethylnaphthalene	1.8	1.2	Biphenyl	4.8	3.2
2,6-Dimethylnaphthalene	2.6	1.7	Chrysene	12.7	8.4
2-Methylnaphthalene	3.6	2.4	Dibenz[<i>a,h</i>]anthracene	2.5	1.6
Acenaphthene	1.7	1.1	Fluoranthene	25.3	16.7
Acenaphthylene	4.3	2.8	Florene	5.6	3.7
Anthracene	6.4	4.2	Indeno[1,2,3- <i>c,d</i>]pyrene	3.6	2.4
Benz[<i>a</i>]pyrene	5.8	3.8	Naphthalene	11.9	7.9
Benz[<i>b</i>]fluoranthene	8.8	5.8	Perylene	3.0	2.0
Benz[<i>e</i>]pyrene	7.1	4.7	Phenanthrene	23.4	15.5
Benz[<i>gh</i>]perylene	4.3	2.8	Pyrene	24.3	16.1

Within Sample S1: Three gas chromatographic (GC) replicates of sample 1 (S1).

Mean Absolute %Error: Accuracy indicator. The mean of the absolute percent errors of the three sample 1 replicates, S1-A, S1-B and S1-C, relative to the NIST gravimetric value.

S1 %RSD: Precision indicator. The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.

S1 Mean: The mean value of the reported S1 replicates, S1-A, S1-B and S1-C.

Between Samples S1, S2, S3: Three independent sample preparations.

Mean Absolute %Error: The mean of the absolute percent errors of the S1 mean and the reported samples, S2 and S3 relative to the NIST gravimetric value.

S1-3 %RSD: The percent relative standard deviation of the S1 mean and the reported samples, S2 and S3.

S1-3 Mean: The mean concentration of the laboratory's reported concentrations for the three samples, S1, S2 and S3, in which the mean value of the three GC replicates was used for the S1 concentration.

Table V.1. 1989 Polycyclic aromatic hydrocarbons in hexane and toluene [QA89S1AH (V/AR2-PAH)] composition and intercomparison exercise results ($\mu\text{g}/\text{mL}$ unless noted) (cont.)

BATTELLE

Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A		S1-B		S1-C		S1 Mean	S1 %RSD	S2 Mean	S2 %RSD	S3 Mean	S3 %RSD
		%Error	%RSD	%Error	%RSD	%Error	%RSD	%Error	%RSD	%Error	%RSD	%Error	%RSD
1-Methylnaphthalene	3.2	3.3	3.3	2.4	0.8	3.3	3.4	3.4	0.5	3.1	0.5	3.3	3.3
1-Methylphenanthrene	3.7	3.6	3.7	3.6	2.1	0.5	3.6	3.7	3.6	2.6	1.6	3.6	3.6
1,6,7-Trimethylnaphthalene	1.2	1.2	1.2	1.1	1.9	0.4	1.2	1.2	1.2	1.8	0.3	1.2	1.2
2,6-Dimethylnaphthalene	1.7	1.7	1.7	1.7	2.0	0.9	1.7	1.7	1.7	2.1	0.3	1.7	1.7
2-Methylnaphthalene	2.4	2.5	2.5	2.5	3.2	0.6	2.5	2.5	2.5	2.8	0.3	2.5	2.5
Acenaphthene	1.1	1.2	1.2	1.2	3.0	0.1	1.2	1.2	1.2	2.8	0.2	1.2	1.2
Acenaphthylene	2.8	2.8	2.9	2.8	0.7	0.8	2.8	2.8	2.8	2.9	0.6	0.7	2.8
Anthracene	4.2	4.1	4.1	4.1	2.5	0.2	4.1	4.2	4.0	2.8	1.4	4.1	4.1
Benzol[a]pyrene	3.8	3.8	3.9	3.9	0.7	0.5	3.8	4.0	3.7	2.3	2.6	3.9	3.9
Benzol[b]fluoranthene	5.8	6.0	5.9	6.1	2.4	1.3	6.0	6.2	5.8	3.0	2.7	6.0	6.0
Benzol[e]pyrene	4.7	4.7	4.7	4.7	1.0	0.2	4.7	4.9	4.6	2.2	2.3	4.7	4.7
Benzol[g,h]perylene	2.8	2.8	2.8	2.8	1.0	0.1	2.8	2.9	2.7	2.6	2.8	2.8	2.8
Benzol[k]fluoranthene	6.3	6.5	6.5	6.4	2.1	0.7	6.4	6.6	6.3	2.5	1.7	6.5	6.5
Benz[a]anthracene	6.6	6.5	6.4	6.5	2.2	0.2	6.5	6.7	6.4	1.9	1.6	6.5	6.5
Biphenyl	3.2	3.2	3.3	3.2	1.2	1.2	3.2	3.2	3.2	3.3	1.6	3.2	3.2
Chrysene	8.4	8.6	8.5	8.6	2.0	0.5	8.6	8.8	8.6	3.0	1.3	8.6	8.6
Dibenz[a,h]anthracene	1.6	1.6	1.6	1.6	1.8	0.4	1.6	1.6	1.6	2.3	1.5	1.6	1.6
Fluoranthene	16.7	14.9	15.0	14.9	10.6	0.1	14.9	15.0	14.7	10.8	0.9	14.9	14.9
Fluorene	3.7	4.2	4.2	4.2	14.5	0.5	4.2	4.3	4.2	14.3	0.8	4.2	4.2
Indeno[1,2,3-cd]pyrene	2.4	2.4	2.4	2.3	1.8	0.5	2.4	2.5	2.2	3.6	3.8	2.4	2.4
Naphthalene	7.9	8.2	8.2	8.2	4.3	0.3	8.2	8.1	8.4	4.4	1.5	8.2	8.2
Perylene	2.0	2.0	2.0	2.0	0.3	0.3	2.0	2.1	1.9	2.5	2.0	2.0	2.0
Phenanthrene	15.5	14.8	14.8	14.8	4.4	0.1	14.8	15.0	14.7	4.2	0.9	14.8	14.8
Pyrene	16.1	14.4	14.5	14.5	10.0	0.3	14.5	14.6	14.2	10.3	1.1	14.4	14.4

Table V.1. 1989 Polycyclic aromatic hydrocarbons in hexane and toluene [QA89S1AH (VAR2-PAH)] composition and intercomparison exercise results ($\mu\text{g}/\text{mL}$ unless noted) (cont.)

NAF	Compound	NIST Assigned	Within Sample - S1				Between Samples - S1, S2, S3				
			S1-A	S1-B	S1-C	Mean	S1	S2	S3	Mean	
			%Error	%RSD	Mean		%Error	%RSD	Mean		
	1-Methylnaphthalene		3.2	3.6		3.6	3.2	3.1	5.4	6.4	3.3
	1-Methylphenanthrene		3.7	3.5		3.5	3.5	3.4	7.4	0.9	3.5
	1,6,7-Trimethylnaphthalene		1.2	0.9		0.9	0.9	0.8	23.4	4.6	0.9
	2,6-Dimethylnaphthalene		1.7	1.5		1.5	1.5	1.4	13.5	3.6	1.5
	2-Methylnaphthalene		2.4	2.0		2.0	1.9	2.0	17.8	1.7	2.0
	Acenaphthene		1.1	1.1		1.1	1.0	1.1	6.8	4.1	1.1
	Acenaphthylene		2.8	2.7		2.7	2.5	2.6	8.0	2.1	2.6
	Anthracene		4.2	4.0		4.0	4.0	3.9	6.0	1.6	4.0
	Benzol[a]pyrene		3.8	4.3		4.3	4.0	4.0	7.5	3.6	4.1
	Benzol[b]fluoranthene		5.8	6.6		6.6	6.5	6.5	12.0	0.4	6.5
	Benzol[e]pyrene		4.7	3.1		3.1	2.9	2.8	37.9	4.4	2.9
	Benzol[ghi]perylene		2.8	2.4		2.4	2.2	2.1	20.6	6.4	2.2
	Benzol[k]fluoranthene		6.3	9.0		9.0	8.6	8.7	39.7	1.7	8.8
	Benzol[a,h]anthracene		6.6	7.1		7.1	6.8	7.1	6.4	1.8	7.0
	Biphenyl		3.2	3.3		3.3	3.0	3.3	3.3	3.6	3.2
	Chrysene		8.4	9.8		9.8	9.5	9.4	13.8	1.7	9.6
	Dibenzol[a,h]anthracene		1.6	1.6		1.6	1.4	1.5	9.1	5.0	1.5
	Fluoranthene		16.7	20.3		20.3	20.0	19.6	19.6	1.4	20.0
	Fluorene		3.7	3.5		3.5	3.7	3.5	4.1	3.1	3.5
	Indeno[1,2,3-cd]pyrene		2.4	2.6		2.6	2.5	2.6	7.8	1.7	2.6
	Naphthalene		7.9	8.2		8.2	8.1	8.4	4.2	1.6	8.2
	Perylene		2.0	3.9		3.9	3.6	3.5	84.9	4.4	3.7
	Phenanthrene		15.5	17.8		17.8	17.3	17.4	13.2	1.1	17.5
	Pyrene		16.1	19.9		19.9	19.2	18.8	20.0	2.3	19.3

Table V.1. 1989 Polycyclic aromatic hydrocarbons in hexane and toluene [QA89S1AH (VAR2-PAH)] composition and intercomparison exercise results ($\mu\text{g/mL}$ unless noted) (cont.)

Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A		S1-B		S1-C		S1	S1	S2	S3	S1-3	S1-3
		%Error	%RSD	%Error	%RSD	%Error	%RSD	Mean	%Error	Mean	%Error	Mean	%RSD
1-Methylnaphthalene	3.2	3.2	3.2	0.9	0.5	3.2	3.1	3.3	1.9	2.1	3.2	3.2	3.2
1-Methylphenanthrene	3.7	3.8	4.0	5.4	2.4	3.9	3.6	3.6	3.5	3.8	3.7	3.7	3.7
1,6,7-Trimethylnaphthalene	1.2	1.2	1.2	2.4	1.8	1.2	1.2	1.5	1.5	1.8	1.2	1.2	1.2
2,6-Dimethylnaphthalene	1.7	1.7	1.6	4.6	2.8	1.6	1.6	6.2	6.2	2.4	1.6	1.6	1.6
2-Methylnaphthalene	2.4	2.6	2.6	2.5	6.9	1.8	2.6	2.5	4.5	4.5	1.7	2.5	2.5
Acenaphthene	1.1	1.2	1.2	8.5	0.8	1.2	1.2	1.2	5.4	5.4	2.5	1.2	1.2
Acenaphthylene	2.8	2.9	2.9	2.7	1.1	2.9	2.8	2.9	1.4	1.4	1.0	2.9	2.9
Anthracene	4.2	4.1	4.3	4.3	1.7	2.0	4.2	4.0	4.1	4.1	3.0	2.5	4.1
Benzol[a]pyrene	3.8	4.4	4.2	4.2	11.4	3.1	4.3	4.4	4.1	11.5	2.5	4.3	4.3
Benzol[b]fluoranthene	5.8	5.1	5.4	5.3	9.6	2.4	5.3	6.8	5.4	11.5	12.1	5.8	5.8
Benzol[e]pyrene	4.7	4.8	4.4	4.4	4.4	3.7	4.6	4.6	4.6	4.6	2.2	0.6	4.6
Benzol[g,h]perylene	2.8	3.3	2.7	3.1	9.3	7.4	3.0	2.8	2.4	7.7	9.5	2.7	2.7
Benzol[k]fluoranthene	6.3	5.8	5.8	7.1	10.0	10.4	6.2	5.4	7.3	10.4	12.4	6.3	6.3
Benz[a]anthracene	6.6	6.0	6.0	9.3	0.4	6.0	6.0	5.7	10.8	2.8	5.9	5.9	5.9
Biphenyl	3.2	3.1	3.0	3.6	1.1	3.1	3.0	3.0	5.0	5.0	1.2	3.0	3.0
Chrysene	8.4	8.1	8.2	8.6	3.0	2.9	8.3	8.8	8.3	2.5	2.9	8.5	8.5
Dibenz[a,h]anthracene	1.6	1.8	2.0	2.0	16.6	6.3	1.9	2.3	1.8	22.8	10.2	2.0	2.0
Fluoranthene	16.7	15.7	18.2	18.5	8.7	7.4	17.5	15.7	15.4	6.1	5.7	16.2	16.2
Fluorene	3.7	4.0	4.1	3.9	8.1	1.3	4.0	3.8	3.9	5.1	2.2	3.9	3.9
Indeno[1,2,3-cd]pyrene	2.4	2.5	2.2	2.4	3.3	4.3	2.4	2.5	1.9	8.9	11.7	2.2	2.2
Naphthalene	7.9	8.0	8.0	8.0	2.2	0.1	8.0	7.8	8.1	1.9	1.4	8.0	8.0
Perylene	2.0	2.2	2.3	2.2	12.6	1.2	2.2	2.4	2.3	15.4	2.6	2.3	2.3
Phenanthrene	15.5	15.3	15.3	15.4	1.0	0.3	15.3	15.1	15.1	1.9	0.6	15.2	15.2
Pyrene	16.1	14.6	17.3	17.7	8.7	8.2	16.5	14.8	14.4	7.3	6.2	15.2	15.2

Table V.2. 1989 Polychlorinated biphenyls in 2,2,4-trimethylpentane [QA89S1CB (VAR2-PCB)] composition and intercomparison exercise results (ng/mL unless noted)

Gravimetric concentration of components of QA89S1CB (VAR2-PCB) prepared by NIST					
Compound	(ng/g)	(ng/mL at 20°C)	Compound	(ng/g)	(ng/mL at 20°C)
PCB 8	38.4	26.5	PCB 128	106.5	73.5
PCB 18	14.3	98.6	PCB 138	1066	736
PCB 28	264	182	PCB 153	992	685
PCB 44	68.4	47.2	PCB 170	139	96
PCB 52	278	192	PCB 180	345	238
PCB 66	274	189	PCB 187	438	302
PCB 101	493	341	PCB 195	23.9	16.5
PCB 105	168	116	PCB 206	27.1	18.7
PCB 118	492	340	PCB 209	33.7	23.3

Within Sample S1: Three gas chromatographic (GC) replicates of sample 1 (S1).

Mean Absolute %Error: Accuracy indicator. The mean of the absolute percent errors of the three sample 1 replicates, S1-A, S1-B and S1-C, relative to the NIST gravimetric value.

S1 %RSD: Precision indicator. The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.

S1 Mean: The mean value of the reported S1 replicates, S1-A, S1-B and S1-C.

Between Samples S1, S2, S3: Three independent sample preparations.

Mean Absolute %Error: The mean of the absolute percent errors of the S1 mean and the reported samples, S2 and S3 relative to the NIST gravimetric value.

S1-3 %RSD: The percent relative standard deviation of the S1 mean and the reported samples, S2 and S3.

S1-3 Mean: The mean concentration of the laboratory's reported concentrations for the three samples, S1, S2 and S3, in which the mean value of the three GC replicates was used for the S1 concentration.

Table V.2. 1989 Polychlorinated biphenyls in 2,2,4-trimethylpentane [QA89S1CB (VAR2-PCB)] composition and intercomparison exercise results (ng/mL unless noted) (cont.)

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Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A		S1-B	S1-C	S1 Mean	S1 %RSD	S2	S3	S1 Mean	S1-3 %RSD	S1-3 Mean	
		%Error	%RSD					%Error	%RSD				
PCB 8	27	31	32	18.14	1.18	31	3.2	32	0.48	0.52	31		
PCB 18	99	102	105	5.89	1.34	104	10.4	105	0.37	0.39	105		
PCB 28	182	181	177	18.3	1.28	180	1.43	178	180	0.43	0.45	180	
PCB 52	192	190	188	18.8	1.74	0.48	1.88	186	188	0.54	0.58	188	
PCB 44	47	54	53	13.11	0.89	53	5.3	53	54	0.48	0.57	53	
PCB 66	189	205	189	19.5	3.84	3.28	1.96	193	196	0.60	0.65	195	
PCB 101	340	335	316	32.1	4.90	2.44	32.4	319	319	0.71	0.75	320	
PCB 118	340	360	317	32.8	5.43	5.49	33.5	329	317	2.07	2.29	327	
PCB 153	685	643	571	59.7	11.88	4.95	60.4	593	571	2.08	2.33	589	
PCB 105	116	124	109	11.9	5.03	5.26	11.7	117	112	1.82	1.95	116	
PCB 138	735	702	612	650	11.02	5.61	654	648	615	2.52	2.71	639	
PCB 187	302	312	270	284	6.66	6.10	289	284	266	3.18	3.45	280	
PCB 128	74	81	72	7.9	6.06	4.51	7.7	7.8	7.4	2.29	2.47	76	
PCB 180	238	259	211	22.9	7.87	8.42	23.3	228	210	4.09	4.46	223	
PCB 170	96	107	87	9.6	6.79	8.16	9.7	9.5	8.8	3.86	4.17	93	
PCB 195	16	18	15	1.6	7.87	9.02	1.6	16	15	4.54	4.92	16	
PCB 206	19	22	17	1.9	8.40	9.41	1.9	19	17	5.33	5.71	18	
PCB 209	23	29	23	25	11.12	9.53	25	25	22	5.33	5.74	24	

Table V.2. 1989 Polychlorinated biphenyls in 2,2,4-trimethylpentane [QA89S1CB (VAR2-PCB)] composition and intercomparison exercise results (ng/ml unless noted) (cont.)

NAF	Compound	NST Assigned	Within Sample - S1				Between Samples - S1, S2, S3			
			S1-A	S1-B	S1-C	Mean	S1	S2	S3	Mean
			%Error	%RSD	Mean		%Error	%RSD	Mean	%RSD
	PCB 8	27	NR				NR			
	PCB 18	99	105				105			
	PCB 28	182	166				165			
	PCB 52	192	189				188			
	PCB 44	47	50				49			
	PCB 66	189	178				177			
	PCB 101	340	313				312			
	PCB 118	340	300				300			
	PCB 153	685	628				632			
	PCB 105	116	93				92			
	PCB 138	735	651				656			
	PCB 187	302	263				264			
	PCB 128	74	63				62			
	PCB 180	238	205				205			
	PCB 170	96	84				84			
	PCB 195	16	14				14			
	PCB 206	19	20				20			
	PCB 209	23	22				21			

NR - Not reported.

Table V.2. 1989 Polychlorinated biphenyls in 2,2,4-trimethylpentane [QA89S1CB (VAR2-PCB)] composition and intercomparison exercise results (ng/mL unless noted) (cont.)

Compound	NIST Assigned	Within Sample - S1				Between Samples - S1, S2, S3			
		S1-A	S1-B	S1-C	Mean	S1	S2	S3	Mean
		%Error	%RSD	%Error	Mean	%RSD	%Error	%RSD	Mean
PCB 8	27	25	26	26	4.54	1.71	2.5	2.5	2.7
PCB 18	99	99	100	99	0.76	0.53	0.99	100	101
PCB 28	182	180	180	180	1.39	0.16	1.80	180	1.26
PCB 52	192	193	192	191	0.49	0.56	1.92	193	1.19
PCB 44	47	46	46	45	3.44	0.41	4.6	4.6	0.25
PCB 66	189	191	193	194	1.92	0.64	1.93	193	0.17
PCB 101	340	345	342	343	0.82	0.31	343	343	1.16
PCB 118	340	350	355	362	4.65	1.36	3.56	353	0.25
PCB 153	685	686	681	692	0.53	0.62	0.86	680	1.16
PCB 105	116	119	121	123	3.92	1.29	1.21	120	0.66
PCB 138	735	744	744	757	1.72	0.81	748	737	1.50
PCB 187	302	306	302	304	0.69	0.56	3.04	301	0.66
PCB 128	74	74	75	76	1.78	1.04	75	75	0.66
PCB 180	238	244	244	250	3.41	1.02	2.46	242	0.66
PCB 170	96	101	101	103	5.77	1.11	1.02	101	0.66
PCB 195	16	17	16	17	1.68	1.72	1.17	18	0.66
PCB 206	19	20	19	20	5.78	2.30	2.0	21	0.66
PCB 209	23	27	26	26	11.60	1.58	2.6	24	0.66

Table V.3. 1989 Pesticides in hexane [QA89S1PE (VAR2-PES)] composition and intercomparison exercise results (ng/mL unless noted)

Gravimetric concentration of components of QA89S1PE (VAR2-PES) prepared by NIST					
Compound	(ng/g)	(ng/mL at 20°C)	Compound	(ng/g)	(ng/mL at 20°C)
2,4'-DDD	60.3	39.5	Dieldrin	137	89.8
2,4'-DDE	48.6	31.9	gamma-HCH	25.5	16.7
2,4'-DDT	29.9	19.6	Heptachlor	17	11.1
4,4'-DDD	170	112	Heptachlor epoxide	57.7	37.8
4,4'-DDE	547	359	Hexachlorobenzene	28.8	18.9
4,4'-DDT	47.8	31.3	Mirex	27.7	18.2
Aldrin	51.6	33.9	<i>trans</i> -Nonachlor	91.6	60.1
<i>cis</i> -Chlordane	95.5	62.6			

Within Sample S1: Three gas chromatographic (GC) replicates of sample 1 (S1).

Mean Absolute %Error: Accuracy indicator. The mean of the absolute percent errors of the three sample 1 replicates, S1-A, S1-B and S1-C, relative to the NIST gravimetric value.

S1 %RSD: Precision indicator. The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.

S1 Mean: The mean value of the reported S1 replicates, S1-A, S1-B and S1-C.

Between Samples S1, S2, S3: Three independent sample preparations.

Mean Absolute %Error: The mean of the absolute percent errors of the S1 mean and the reported samples, S2 and S3 relative to the NIST gravimetric value.

S1-3 %RSD: The percent relative standard deviation of the S1 mean and the reported samples, S2 and S3.

S1-3 Mean: The mean concentration of the laboratory's reported concentrations for the three samples, S1, S2 and S3, in which the mean value of the three GC replicates was used for the S1 concentration.

Table V.3. 1989 Pesticides in hexane [QA89S1PE (VAR2-PES)] composition and intercomparison exercise results (ng/mL unless noted)
(cont.)

Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A		S1-B	S1-C	S1 Mean	%Error	S1 Mean	S2	S3	S1-3 Mean	%RSD	S1-3 Mean
		%	%	%	%	%RSD	%	%	%	%	%	%	%
2,4'-DDD	40	4.5				4.9		5.2		6.48	3.15	4.9	
2,4'-DDE	32	3.7				4.0		3.9		3.71	1.43	3.9	
2,4'-DDT	20	2.1				2.4		2.6		8.32	1.97	2.4	
4,4'-DDD	112	10.2				12.2		13.5		11.5	13.7	11.9	
4,4'-DDE	359	3.25				3.56		3.82		6.61	23.4	3.54	
4,4'-DDT	31	2.6				3.2		3.6		12.9	4.05	3.1	
Aldrin	34	4.0				4.2		4.3		2.73	1.14	4.2	
c/s-Chlordane	63	6.9				7.3		7.6		3.91	2.86	7.3	
Dieldrin	90	9.8				10.3		10.6		3.54	3.61	10.2	
gamma-HCH	17	1.5				1.6		1.6		2.78	0.44	1.6	
Heptachlor	11	1.3				1.4		1.4		3.38	0.47	1.4	
Heptachlor epoxide	38	4.3				4.5		4.6		3.38	1.51	4.5	
Hexachlorobenzene	19	2.2				2.2		2.3		0.84	0.19	2.2	
Mirex	18	2.1				2.3		2.5		6.32	1.46	2.3	
trans-Nonachlor	60	6.6				7.0		7.2		3.42	2.36	6.9	

Table V.3. 1989 Pesticides in hexane [QA89S1PE (VAR2-PES)] composition and intercomparison exercise results (ng/mL unless noted)
(cont.)

Compound	NAF NIST Assigned	Within Sample - S1			Between Samples - S1, S2, S3		
		S1-A	S1-B	S1-C	S2	S3	S1-3 Mean
		%Error	%RSD	%Error	%RSD	%RSD	Mean
2,4'-DDD	40	9	9	9	9	9	2.10 9
2,4'-DDE	32	29	29	28	29	10.5	0.66 29
2,4'-DDT	20	19	19	19	19	1.9	0.78 19
4,4'-DDD	112	92	92	90	94	17.9	1.63 92
4,4'-DDE	359	328	325	331	331	8.6	0.71 328
4,4'-DDT	31	30	30	30	30	2.9	0.11 30
Aldrin	34	44	44	42	43	26.7	1.65 43
cis-Chlordane	63	57	57	56	57	9.6	0.57 57
Dieldrin	90	75	75	74	75	16.7	0.65 75
gamma-HCH	17	18	18	18	18	10.0	0.26 18
Heptachlor	11	15	15	15	15	37.3	0.60 15
Heptachlor epoxide	38	35	35	34	35	8.7	0.69 35
Hexachlorobenzene	19	18	18	18	18	2.9	0.66 18
Mirex	18	17	17	17	17	8.2	0.71 17
trans-Nonachlor	60	54	54	54	54	9.9	0.60 54

Table V.3. 1989 Pesticides in hexane [QA89S1PE (VAR2-PES)] composition and intercomparison exercise results (ng/mL unless noted)
(cont.)

Compound	NIST Assigned	Within Sample - S1				Between Samples - S1, S2, S3						
		S1-A	S1-B	S1-C	Mean	S1	S2	S3	Mean			
		%Error	%RSD	%RSD	Mean	%Error	%RSD	%RSD	Mean			
2,4'-DDD	40	2.8	2.9	2.7	28.8	2.62	2.8	2.9	3.1	26.0	4.29	29
2,4'-DDE	32	3.6	3.6	3.5	12.3	1.15	3.6	3.6	3.7	13.7	1.60	36
2,4'-DDT	20	1.9	1.9	1.9	3.1	1.29	1.9	1.9	2.0	2.4	1.96	19
4,4'-DDD	112	121	119	118	7.0	1.14	11.9	12.0	12.2	7.9	0.74	120
4,4'-DDE	359	374	371	366	3.3	0.83	3.70	3.69	3.70	3.1	0.13	370
4,4'-DDT	31	3.3	3.3	3.2	4.7	1.32	3.3	3.3	3.4	6.5	1.35	33
Aldrin	34	38	36	37	9.8	2.88	3.7	3.8	3.9	11.9	1.63	38
cis-Chlordane	63	70	69	68	10.5	1.42	6.9	7.0	7.1	11.4	0.85	70
Dieldrin	90	98	98	94	7.4	1.76	9.6	9.5	9.8	7.4	0.93	96
gamma-HCH	17	20	19	19	14.4	1.72	1.9	1.9	2.0	16.7	1.86	20
Heptachlor	11	12	12	12	6.6	1.43	1.2	1.2	1.2	8.6	1.87	12
Heptachlor epoxide	3.8	4.3	4.2	4.1	10.7	1.46	4.2	4.2	4.3	11.6	1.14	42
Hexachlorobenzene	19	22	21	21	14.2	2.09	2.2	2.2	2.3	16.6	1.96	22
Mirex	18	17	16	16	8.5	3.07	1.7	1.7	1.7	7.3	1.22	17
trans-Nonachlor	60	68	67	66	11.4	1.44	6.7	6.7	6.8	12.1	0.74	67

Table V.4. 1989 Oyster tissue [QA89T1] intercomparison exercise results (ng/g dry weight)

NIST	Compound	Values	%RSD	Mean	Compound	Values	%RSD	Mean	
	1-Methylnaphthalene	NR	NR	2,4'-DDD	3.9	3.8	4.0	2.1	3.9
	1-Methylphenanthrene	NR	355	2,4'-DDE	168	159	160	2.5	162
	1,6,7-Trimethylnaphthalene	NR	NR	2,4'-DDT	12	12	12	1.4	12
	2,6-Dimethylnaphthalene	NR	NR	4,4'-DDD	4.5	4.4	4.4	0.6	4.4
	2-Methylnaphthalene	NR	NR	4,4'-DDE	246	224	233	3.9	235
	Acenaphthene	NR	NR	4,4'-DDT	0.9	0.8	0.8	3.5	0.8
	Acenaphthylene	NR	NR	Aldrin	ZR	ZR	ZR		
	Anthracene	NR	169	cis-Chlordane	1.3	1.3	1.3	1.1	1.3
	Benzofluoranthenes *	NR	130	Dieldrin	ZR	ZR	ZR		
	Benz[a]pyrene	NR	ZR	gamma-HCH	ZR	ZR	ZR		
	Benz[e]pyrene	NR	37	Heptachlor	0.6	0.5	0.6	6.6	0.6
	Benzol[g]perylene	NR	ZR	Heptachlor epoxide	ZR	ZR	ZR		
	Benz[a]anthracene	NR	192	Hexachlorobenzene	20	19	19	2.2	20
	Biphenyl	NR	NR	Mirex	1.2	1.1	1.2	1.8	1.2
	Chrysene	NR	309	trans-Nonachlor	0.6	0.6	0.6	1.9	0.6
	Dibenz[a,h]anthracene	NR	ZR						
	Fluoranthene	NR	707	734	720				
	Fluorene	NR	NR						
	Indeno[1,2,3-cd]pyrene	NR	ZR						
	Naphthalene	NR	NR						
	Perylene	NR	ZR						
	Phenanthrene	NR	493	473	483				
	Pyrene	NR	543	510	527				

Z R - Zero or below detection limit. NR - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

%RSD: The percent relative standard deviation of the S1 mean and the reported samples, S2 and S3.
Mean: The mean concentration of the laboratory's reported concentrations for the three samples .

Table V.4. 1989 Oyster tissue [QA89T1] intercomparison exercise results (ng/g dry weight) (cont.)

NIST	Compound	Values	%RSD	Mean
	PCB 8	32	27	9.0
	PCB 18	24	23	2.1
	PCB 28	5.8	5.5	2.5
	PCB 44	5.6	5.3	1.9
	PCB 52	21	19	3.3
	PCB 66	28	26	3.0
	PCB 101	32	30	3.1
	PCB 105	10	9	4.0
	PCB 118	23	21	3.4
	PCB 128	NR	NR	
	PCB 138	28	26	2.9
	PCB 153	37	35	2.5
	PCB 170	1.1	1.0	3.0
	PCB 180	1.2	1.0	4.5
	PCB 187	12	10	1.1
	PCB 195	ZR	ZR	4.5
	PCB 206	ZR	ZR	11
	PCB 209	ZR	ZR	

Z R - Zero or below detection limit. N R - Not reported.

Table V.4. 1989 Oyster tissue [QA89T1] intercomparison exercise results (ng/g dry weight) (cont.)

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Compound	Values	%RSD	Mean	Compound	Values	%RSD	Mean
1-Methylnaphthalene	86	82	84	2.2	84	2,4'-DDD	3.5
1-Methylphenanthrene	196	207	201	2.3	201	2,4'-DDE	127
1,6,7-Trimethylnaphthalene	138	148	155	4.6	147	2,4'-DDT	16
2,6-Dimethylnaphthalene	223	201	220	4.4	215	4,4'-DDD	91
2-Methylnaphthalene	150	147	146	1.1	148	4,4'-DDE	121
Acenaphthene	39	39	37	3.1	38	4,4'-DDT	5.3
Acenaphthylene	15	15	17	8.0	16	Aldrin	NR
Anthracene	55	57	59	2.7	57	cis-Chlordane	19
Benzofluoranthenes *	93	96	95	1.3	95	Dieldrin	16
Benzo[a]pyrene	NR	NR	NR	gamma-HCH	12	Heptachlor	11
Benzo[e]pyrene	50	52	53	1.9	52	Heptachlor epoxide	NR
Benzo[gh]perylene	7.2	NR	5.9			Hexachlorobenzene	11
Benz[al]anthracene	86	87	89	1.4	87	Mirex	8.8
Biphenyl	33	31	28	5.9	31	trans-Nonachlor	7.1
Chrysene	161	164	174	3.5	166		5.5
Dibenz[a,h]anthracene	NR	NR	NR				5.9
Fluoranthene	519	515	509	0.8	514		15
Fluorene	61	66	66	3.3	64		19
Indeno[1,2,3-cd]pyrene	NR	NR	NR				19
Naphthalene	67	60	59	5.8	62		5.6
Perylene	7.0	10.5	7.5	18.7	8.3		
Phenanthrene	396	418	412	2.2	409		
Pyrene	341	361	335	3.2	346		

Z R - Zero or below detection limit. NR - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table V.4. 1989 Oyster tissue [QA89T1] intercomparison exercise results (ng/g dry weight) (cont.)

BATTELLE

Compound	Values			%RSD	Mean
	NR	NR	NR		
PCB 8	1	1	2	2	2
PCB 18	NR	NR	NR	0.8	0.8
PCB 28	1.1	0.7	0.7	25.3	0.8
PCB 44	9.3	15.5	11.6	21.0	12.1
PCB 52	3.2	2.4	2.8	11.7	2.8
PCB 66	4.1	4.4	2.2	26.5	3.6
PCB 101	2.3	0.6	1.0	54.0	1.3
PCB 105	35	31	33	5.3	3.3
PCB 118	24	22	23	3.9	2.3
PCB 128	20	23	23	7.2	2.2
PCB 138	30	34	32	4.6	3.2
PCB 153	22	20	22	4.0	2.2
PCB 170	4.8	4.9	5.2	3.5	5.0
PCB 180	3.7	6.5	7.2	25.5	5.8
PCB 187	2.8	2.8	2.9	2.6	2.8
PCB 195	1.7	1.7	2.0	7.6	1.8
PCB 206	2.9	3.1	3.5	7.9	3.2
PCB 209	1.5	0.8	1.5	28.6	1.3

Z R - Zero or below detection limit. N R - Not reported.

Table V.4. 1989 Oyster tissue [CA89T1] intercomparison exercise results (ng/g dry weight) (cont.)

NAF	Compound	Values	%RSD	Mean	Compound	Values	%RSD	Mean					
	1-Methylnaphthalene	32	43	42	12.7	39	2,4'-DDD	7.4	6.8	8.1	7.1	7.4	
	1-Methylphenanthrene	620	590	600	2.1	603	2,4'-DDE	130	130	150	6.9	137	
	1,6,7-Trimethylnaphthalene	210	230	220	3.7	220	2,4'-DDT	13	16	17	11.1	15	
	2,6-Dimethylnaphthalene	190	220	240	9.5	217	4,4'-DDD	110	110	130	8.1	117	
	2-Methylnaphthalene	100	120	120	8.3	113	4,4'-DDE	130	120	140	6.3	130	
	Acenaphthene	7.0	7.0	2.0	44.2	5.3	4,4'-DDT	ZR	ZR	ZR	ZR	ZR	
	Acenaphthylene	ZR	ZR	ZR	Aldrin	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
	Anthracene	110	100	88	9.1	99	cis-Chlordane	18	17	20	6.8	18	
	Benzofluoranthenes	25	43	39	21.6	36	Dieldrin	10	10	11	4.6	10	
	Benz[a]pyrene	ZR	ZR	ZR	gamma-HCH	ZR	ZR	ZR	ZR	ZR	ZR	ZR	
	Benz[e]pyrene	0.9	8.0	12	65.9	7.0	Heptachlor	ZR	ZR	ZR	ZR	ZR	ZR
	Benz[ghi]perylene	ZR	ZR	ZR	Heptachlor epoxide	6.0	6.0	7.0	7.4	6.3			
	Benz[a]anthracene	200	220	240	7.4	220	Hexachlorobenzene	6	7	6	7.4	6.3	
	Biphenyl	ZR	0.6	ZR	Mirex	13	13	15	6.9	14			
	Chrysene	390	390	450	6.9	410	trans-Nonachlor	24	24	27	5.7	25	
	Dibenz[a,h]anthracene	ZR	ZR	ZR									
	Fluoranthene	1500	1500	1500	0	1500							
	Fluorene	58	63	61	3.4	61							
	Indeno[1,2,3-cd]pyrene	ZR	ZR	ZR									
	Naphthalene	3	8	4	43.2	5							
	Perylene	ZR	ZR	ZR									
	Phenanthrene	730	720	740	1.1	730							
	Pyrene	1100	1000	1100	4.4	1067							

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table V.4. 1989 Oyster tissue [QA89T1] intercomparison exercise results (ng/g dry weight) (cont.)

NAF	Compound	Values		%RSD	Mean
	PCB 8	10	11	12	7.4 11
	PCB 18	12	12	14	7.4 13
	PCB 28	13	13	15	6.9 14
	PCB 44	13	13	15	6.9 14
	PCB 52	29	30	33	5.5 31
	PCB 66	6	6	7	7.4 6
	PCB 101	28	28	32	6.4 29
	PCB 105	10	11	11	4.4 11
	PCB 118	23	25	30	11.3 26
	PCB 128	11	11	12	4.2 11
	PCB 138	28	27	31	5.9 29
	PCB 153	25	27	28	4.7 27
	PCB 170	2	2	2	0 2
	PCB 180	4	4	4	0 4
	PCB 187	8	8	9	5.7 8
	PCB 195	ZR	ZR	ZR	
	PCB 206	5	7	8	18.7 7
	PCB 209	5	6	6	8.3 6

Z R - Zero or below detection limit. N R - Not reported.

Table V.4. 1989 Oyster tissue [CA89T1] intercomparison exercise results (ng/g dry weight) (cont.)

TAMU	Compound	Values	%RSD	Mean	Compound	Values	%RSD	Mean	
	1-Methylnaphthalene	81	7.3	62	10.7	72	2,4'-DDD	5.8	5.2
	1-Methylphenanthrene	115	116	122	2.6	118	2,4'-DDE	9.3	9.1
	1,6,7-Trimethylnaphthalene	119	152	153	11.1	141	2,4'-DDT	1.1	1.2
	2,6-Dimethylnaphthalene	154	166	167	3.7	162	4,4'-DDD	7.8	7.6
	2-Methylnaphthalene	130	133	126	2.3	130	4,4'-DDE	9.9	10.0
	Acenaphthene	39	43	37	6.9	4.0	4,4'-DDT	ZR	ZR
	Acenaphthylene	3.7	3.8	3.3	6.0	3.6	Aldrin	ZR	ZR
	Anthracene	13	19	11	23.3	14	cis-Chlordane	6.7	6.1
	Benzofluoranthenes	99	99	84	7.7	94	Dieldrin	3.4	2.7
	Benz[a]pyrene	16	9.1	10	25.6	12	gamma-HCH	1.0	1.0
	Benz[e]pyrene	4.5	5.4	8.1	25.3	6.0	Heptachlor	ZR	2.9
	Benz[gh]perylene	2.8	1.5	1.1	40.3	1.8	Heptachlor epoxide	1.3	1.1
	Benz[a]anthracene	73	83	66	9.5	74	Hexachlorobenzene	ZR	6.5
	Biphenyl	16	23	21	14.5	20	Mirex	ZR	1.1
	Chrysene	154	173	162	4.9	163	trans-Nonachlor	14	1.5
	Dibenz[a,h]anthracene	3.2	4.1	3.5	10.4	3.6		15	1.5
	Fluoranthene	331	368	329	5.3	342			
	Fluorene	53	45	50	6.9	4.9			
	Indeno[1,2,3-cd]pyrene	1.0	2.0	3.1	42.2	2.0			
	Naphthalene	55	68	52	11.8	59			
	Perylene	16	19	14	12.7	16			
	Phenanthrene	213	243	241	5.9	232			
	Pyrene	220	250	232	5.3	234			

Z R - Zero or below detection limit. N R - Not reported.

* Benzo[b]fluoranthene and benzo[k]fluoranthene.

Table V.4. 1989 Oyster tissue [QA89T1] intercomparison exercise results (ng/g dry weight) (cont.)

TAMU	Compound	Values			%RSD	Mean
	PCB 8	5.7	4.6	5.5	8.9	5.3
	PCB 18	ZR	ZR	ZR		
	PCB 28	4.4	3.3	5.0	16.8	4.3
	PCB 44	ZR	ZR	ZR		
	PCB 52	5.0	5.1	4.1	8.8	4.7
	PCB 66	6.4	7.9	6.2	10.8	6.8
	PCB 101	18	17	18	3.0	17
	PCB 105	35	33	33	2.7	34
	PCB 118	13	13	12	2.9	12
	PCB 128	3.1	2.8	3.5	9.9	3.1
	PCB 138	20	19	16	8.5	19
	PCB 153	26	20	22	11.6	22
	PCB 170	ZR	ZR	ZR		
	PCB 180	1.2	0.9	0.9	12.4	1.0
	PCB 187	3.9	3.3	3.1	9.4	3.4
	PCB 195	ZR	ZR	ZR		
	PCB 206	5.5	5.8	5.2	4.8	5.5
	PCB 209	ZR	ZR	ZR		

Z R - Zero or below detection limit. N R - Not reported.

Table V.5. 1989 ICES/IOC/OSPARCOM polychlorinated biphenyls in marine media (first step) intercomparison exercise results (ng/mL unless noted)

Assigned ICES value	Congener	(ng/mL)	Compound		%RSD	%RSD
			Polar column	Polar column		
	PCB 28	75.0	PCB 118	75.0	1.8	74.7
	PCB 31	75.0	PCB 138	75.0	0.6	77.4
	PCB 52	79.1	PCB 153	75.0	2.6	64.8
	PCB 101	75.0	PCB 180	75.0	7.8	81.1
	PCB 105	75.0	PCB 189	75.0	5.8	75.4
	PCB 118	70.9			5.5	76.0
	PCB 138	76.4			4.6	76.8
	PCB 153	85.7			4.1	84.3
	PCB 180	70.1			9.0	73.4
	PCB 189	71.0			4.8	78.9
NIST						
Non-polar column		%RSD	Mean	Concentration		%RSD
Compound	Concentration			Polar column	Polar column	
PCB 28	71.3	71.5	75.6	72.8	74.4	73.5
PCB 31	74.3	72.6	78.8	75.2	76.8	77.5
PCB 52	68.5	68.2	64.6	67.1	63.4	64.3
PCB 101	87.2	83.6	89.9	86.9	74.9	81.0
PCB 105	75.5	75.1	76.2	0.7	75.6	71.2
PCB 118	70.9	72.4	71.2	1.1	71.5	81.2
PCB 138	76.4	72.5	77.2	3.3	75.4	72.0
PCB 153	85.7	83.6	89.7	3.6	86.3	79.5
PCB 180	70.1	72.2	73.1	2.1	71.8	64.7
PCB 189	71.0	73.2	73.6	1.9	72.6	73.9

Table V.5. 1989 ICES/IOC/OSPARCOM polychlorinated biphenyls in marine media (first exercise) intercomparison exercise results
(ng/mL unless noted) (cont.)

BATTELLE		Non-polar column			Polar column				
Compound		Concentration	%RSD	Mean	Concentration	%RSD	Mean		
PCB 28	75.0	71.0	79.0	5.3	75.0	76.5	77.0	0.6	77.0
PCB 31	88.0	91.0	87.0	2.3	88.7	76.5	77.0	0.6	77.0
PCB 52	547	535	542	1.1	541	562	567	0.6	566
PCB 101	98.0	98.0	99.0	0.6	98.3	92.0	92.0	1.2	92.7
PCB 105	66.0	67.0	68.0	1.5	67.0	74.0	74.0	1.5	74.7
PCB 118	99.0	100.0	100.0	0.6	99.7	88.0	88.0	1.9	89.0
PCB 138	74.0	75.0	75.0	0.8	74.7	72.0	72.0	1.4	72.0
PCB 153	85.0	86.0	85.0	0.7	85.3	78.0	80.0	1.9	79.7
PCB 180	86.0	87.0	86.0	0.7	85.3	81.0	85.0	2.5	83.3
PCB 189	84.0	87.0	85.0	1.8	85.3	84.0	90.0	3.4	87.0
TAMU									
PCB 28	83.2	84.2	81.6	1.6	83.0	70.8	70.0	63.6	5.8
PCB 31	66.2	73.7	71.3	5.4	70.4	69.0	73.0	71.4	2.8
PCB 52	NR	NR	NR		NR	NR	NR	NR	71.1
PCB 101	81.9	82.1	81.9	0.1	82.0	79.3	83.6	74.8	5.6
PCB 105	72.5	72.9	71.7	0.8	72.4	70.6	78.5	63.8	79.2
PCB 118	NR	NR	NR		NR	74.0	76.7	68.1	10
PCB 138	71.4	73.6	71.4	1.8	72.1	70.5	75.4	63.7	71.0
PCB 153	80.2	81.4	80.1	0.9	80.6	78.2	84.5	71.9	60.0
PCB 180	72.2	73.5	72.5	0.9	72.7	70.0	76.6	62.3	72.9
PCB 189	71.9	72.0	71.6	0.3	71.8	73.3	75.1	62.2	69.9
									8.4
									78.2
									8.1
									69.6
									70.2

%RSD: Precision indicator. The percent relative standard deviation of replicates. **Mean:** The mean value of the reported replicates.
NR - Not reported

APPENDIX VI

1990 TRACE ORGANIC INTERCOMPARISON EXERCISE MATERIALS AND RESULTS

NIST: National Institute of Standards and Technology
BATTELLE: Battelle Ocean Sciences
NAF: NOAA/NMFS/Northwest Fisheries Science Center
TAMU: Texas A&M University

Table VI.1. 1990 Gravimetric PAHs, PCBs and pesticides mixture in 2,2,4-trimethylpentane [QA90S1MX (VAR3-MIX)] composition and intercomparison exercise results ($\mu\text{g/mL}$ unless noted)

Gravimetric concentration* of components of QA90S1MX (Var3-Mix) prepared by NIST					
AHs	($\mu\text{g/g}$)	($\mu\text{g/mL}$ at 20°C)	PCBs	(ng/g)	(ng/mL at 20°C)
Biphenyl	3.90	2.69	PCB 28	265	182.
Fluorene	4.74	3.27	PCB 44	71.6	49.4
Chrysene	13.8	9.49	PCB 101	412	284.
Benzo[e]pyrene	7.39	5.10	PCB 153	1060.	733.
Benzo[a]pyrene	5.12	3.54	PCB 105	117.	80.5
Benzo[ghi]perylene	3.67	2.53	PCB 195	23.7	16.3
 Pesticides					
gamma-HCH	24.4	(ng/mL at 20°C)	* Concentrations corrected for consensus purity estimations of components		
cis-Chlordane	81.5	16.8			
Dieldrin	149.	56.2			
4,4'-DDE	546.	103.			
2,4'-DDE	46.0	377.			
2,4'-DDT	28.6	31.7			
		19.7			

Qualitative Indicator: Reported compound identification

Within Sample S1: Three gas chromatographic (GC) replicates of sample 1 (S1).

Mean Absolute %Error: Accuracy indicator. The mean of the absolute percent errors of the three sample 1 replicates, S1-A, S1-B and S1-C, relative to the NIST gravimetric value.

S1 %RSD: Precision indicator. The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.

S1 Mean: The mean value of the reported S1 replicates, S1-A, S1-B and S1-C.

Between Samples S1, S2, S3: Three independent sample preparations.

Mean Absolute %Error: The mean of the absolute percent errors of the S1 mean and the reported samples, S2 and S3 relative to the NIST gravimetric value.

S1-3 %RSD: The percent relative standard deviation of the S1 mean and the reported samples, S2 and S3.

S1-3-Mean: The mean concentration of the laboratory's reported concentrations for the three samples, S1, S2 and S3, in which the mean value of the three GC replicates was used for the S1 concentration.

Table VI.1. 1990 Gravimetric PAHs, PCBs and pesticides mixture in 2,2,4-trimethylpentane [QA90S1MX (VAR3-MIX)] composition and intercomparison exercise results ($\mu\text{g/mL}$ unless noted) (cont.)

Compound	NIST Compound reported	Within Sample - S1						Between Samples - S1, S2, S3							
		S1-A		S1-B		S1-C		S1		S2		S3		Mean	
		%Error	%RSD	%Error	%RSD	%Error	%RSD	Mean	S1	S2	S3	Mean	S1-3 %Error	S1-3 %RSD	Mean
PAHs															
Biphenyl	2.69	Biphenyl	2.87	2.90	2.95	8.0	1.4	2.91	2.95	2.92	8.7	0.8	2.93		
Fluorene	3.27	Fluorene	3.95	3.89	3.91	20	0.8	3.92	3.84	3.9	19	1.0	3.89		
Chrysene	9.49	Chrysene	9.47	9.44	9.58	0.6	0.8	9.50	9.27	10.02	2.6	4.0	9.60		
Benzo[e]pyrene	5.10	Benzo[e]pyrene	7.31	7.32	7.26	4.3	0.4	7.30	7.46	7.24	4.4	1.6	7.33		
Benzo[a]pyrene	3.54	Benzo[a]pyrene	5.85	5.79	5.97	6.6	1.6	5.87	6.02	5.83	6.7	1.7	5.91		
Benzo[gh]perylene	2.53	Benzo[gh]perylene	2.01	2.12	2.16	17	3.7	2.10	2.29	1.91	17	9.1	2.10		
PESTICIDES															
gamma-HCH	16.8	gamma-HCH	15.0	14.0	14.0	15	4.0	14.3	15.0	14.0	14	3.5	14.4		
cis-Chlordane	56.2	cis-Chlordane	59.0	58.0	59.0	4.3	1.0	58.7	57.0	59.0	3.5	1.8	58.2		
Dieldrin	103	Dieldrin	105	104	106	1.9	1.0	105	104	105	1.6	0.6	105		
4,4'-DDE	377	4,4'-DDE	527	528	541	4.1	1.5	532	520	519	3.9	1.4	524		
2,4'-DDE	31.7	2,4'-DDE	36.0	35.0	36.0	12	1.6	35.7	36.0	34.0	11	3.0	35.2		
2,4'-DDT	19.7	2,4'-DDT	25.0	25.0	25.0	27	0.0	25.0	25.0	24.0	25	2.3	24.7		
PCB CONGENERS															
PCB 28	182	PCB 28	246	240	243	33	1.2	243	253	230	33	4.8	242		
PCB 44	49.4	PCB 44	67.0	66.0	67.0	35	0.9	66.7	67.0	63.0	33	3.4	65.6		
PCB 101	284	PCB 101	372	368	366	30	0.8	369	385	345	29	5.5	366		
PCB 153	733	PCB 153	878	872	888	20	0.9	879	910	811	18	5.8	867		
PCB 105	80.5	PCB 105	102	101	104	27	1.5	102	102	99.0	26	1.8	101		
PCB 195	16.3	PCB 195	21.0	21.0	21.0	28	0.0	21.0	21.0	20.0	26	2.8	20.7		

Table VI.1. 1990 Gravimetric PAHs, PCBs and pesticides mixture in 2,2,4-trimethylpentane [QA90S1MX (VAR3-MIX)] composition and intercomparison exercise results ($\mu\text{g/mL}$ unless noted) (cont.)

NAF	Compound	NIST Compound reported	Within Sample - S1						Between Samples - S1, S2, S3					
			S1-A		S1-B		S1-C		S1		S2		S3	
			Mean	%Error	Mean	%Error	Mean	%RSD	Mean	%Error	Mean	%RSD	S1-3	S1-3 Mean
PAHs														
Biphenyl	2.69	Biphenyl	2.76	2.80	2.71	2.4	1.5	2.76	2.69	2.74	1.5	1.4	2.73	
Fluorene	3.27	Fluorene	3.16	3.20	3.13	3.3	1.2	3.16	3.15	3.09	4.1	1.2	3.13	
Chrysene	9.49	Chrysene	10.3	10.3	10.2	8.4	0.4	10.3	10.5	10.4	9.2	0.9	10.4	
Benzo[e]pyrene	5.10	Benzo[e]pyrene	5.39	5.36	5.40	5.6	0.4	5.39	5.49	5.39	6.3	1.1	5.42	
Benzo[a]pyrene	3.54	Benzo[a]pyrene	3.85	3.87	3.79	8.5	1.1	3.83	3.87	3.62	6.8	3.6	3.78	
Benzo[gh]perylene	2.53	Benzo[gh]perylene	2.29	2.30	2.26	9.9	1.0	2.28	2.29	2.23	10	1.4	2.27	
PESTICIDES														
gamma-HCH	16.8	gamma-HCH	19.7	20.2	20.6	20.1	2.2	20.2	18.7	16.6	1.1	9.9	18.5	
cis-Chlordane	56.2	cis-Chlordane	69.3	72.1	72.3	26.6	2.3	71.2	73	71.1	27	1.1	71.6	
Dieldrin	103	NOT REPORTED												
4,4'-DDE	377	4,4'-DDE	414	433	433	13.3	2.5	427	447	454	17	3.2	443	
2,4'-DDE	31.7	2,4'-DDE	37.5	39.3	39.4	22.0	2.8	38.7	39.3	37.8	22	1.9	38.6	
2,4'-DDT	19.7	2,4'-DDT	22.6	24.5	24.5	21.0	4.7	23.8	24.5	24.2	23	1.3	24.2	
PCB CONGENERS														
PCB 28	182	PCB 28	208	210	210	14.7	0.6	209	212	213	16	0.8	211	
PCB 44	49.4	PCB 44	60.7	61.9	61.9	24.6	1.1	61.5	63.1	63.3	27	1.6	62.6	
PCB 101	284	PCB 101	235	243	242	15.3	1.8	240	251	257	12	3.3	249	
PCB 153	733	PCB 153	529	555	554	25.5	2.7	546	581	607	21	5.3	578	
PCB 105	80.5	PCB 105	80.5	84.5	84.3	3.2	2.7	83.1	87.8	90.7	8.3	4.4	87.2	
PCB 195	16.3	PCB 195	17.9	18.8	18.7	13.1	2.7	18.5	20.2	20.9	21	6.2	19.8	

Table VI.1. 1990 Gravimetric PAHs, PCBs and pesticides mixture in 2,2,4-trimethylpentane [QA90S1MX (VAR3-MIX)] composition and intercomparison exercise results (µg/mL unless noted) (cont.)

TAMU												
Compound	NIST	Compound reported	Within Sample - S1						Between Samples - S1, S2, S3			
			S1-A	S1-B	S1-C	Mean	%Error	%RSD	S1	S2	S3	Mean
PAHs												
Biphenyl	2.69	Biphenyl	3.00	2.51	2.87	8.3	9.1	2.79	2.71	2.83	3.2	2.2
Fluorene	3.27	Fluorene	3.58	2.94	3.39	7.8	10	3.30	3.20	3.38	2.2	2.7
Chrysene	9.49	Chrysene	11.9	10.9	9.33	14	12	10.7	12.1	11.5	20	6.0
Benz[e]pyrene	5.10	Benz[e]pyrene	6.31	5.91	5.22	14	9.5	5.81	6.60	6.21	22	6.3
Benz[a]pyrene	3.54	Benz[a]pyrene	3.51	3.57	3.12	4.5	7.2	3.40	3.65	3.16	5.9	7.2
Benz[g]perylene	2.53	Benz[g]perylene	2.3	2.27	2.2	10.9	2.3	2.26	2.78	2.44	8	11
PESTICIDES												
gamma-HCH	16.8	gamma-HCH	18.1	15.4	16.9	5.5	8.1	16.8	14.7	13.6	11	11
cis-Chlordane	56.2	cis-Chlordane	48.6	49.9	52.6	10	4.1	50.4	48.0	48.4	13	2.6
Dieldrin	103	Dieldrin	108	128	132	19	11	123	107	111	10	7.3
4,4'-DDE	377	4,4'-DDE	324	331	337	12	2.0	331	318	321	14	2.2
2,4'-DDE	31.7	2,4'-DDE	35.6	42.6	44.9	29	12	41.0	34.8	34.9	16	9.7
2,4'-DDT	19.7	2,4'-DDT	15.0	15.4	16.3	21	4.3	15.6	14.2	14.9	24	4.6
PCB CONGENERS												
PCB 28	182	PCB 28	158	153	167	13	4.2	159	156	154	14	1.8
PCB 44	49.4	PCB 44	46.6	47.7	48.3	3.7	1.8	47.5	44.3	44.6	7.9	3.9
PCB 101	284	PCB 101	263	276	290	4.1	4.8	276	261	265	5.9	2.9
PCB 153	733	PCB 153	723	743	777	3.0	3.7	748	724	734	1.1	1.6
PCB 105	80.5	PCB 105	66.8	68.7	68.9	15	1.7	68.1	66.0	68.0	16	1.8
PCB 195	16.3	PCB 195	13.3	13.4	14.3	16	4	13.7	13.9	13.4	16	1.8

Table VI 2. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results ($\mu\text{g}/\text{ampoule}$ unless noted)

NIST Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A		S1-B	S1-C	Mean	%Error	S1	S1	S2	S3	Mean	%Error
		%RSD	Mean	%RSD	Mean	%RSD	Mean	S1	S1	S2	S3	Mean	%RSD
PAHs													
Biphenyl	2.81	2.93	2.99	2.95	5.2	1.0	2.96	3.03	2.91	5.5	2.0	2.97	
Fluorene	3.39	3.47	3.52	3.44	2.5	1.2	3.48	3.59	3.52	4.0	1.6	3.53	
Chrysene	8.11	7.98	8.09	8.03	0.9	0.7	8.03	8.11	8.05	0.6	0.5	8.06	
Benzo[<i>e</i>]pyrene	4.84	4.71	4.78	4.76	1.9	0.8	4.75	4.87	4.83	0.9	1.3	4.82	
Benzo[a]pyrene	3.72	3.71	3.66	3.69	0.8	0.7	3.69	3.77	3.72	0.8	1.1	3.73	
Benzo[<i>ghi</i>]perylene	2.52	2.66	2.61	2.63	4.4	1.0	2.63	2.70	2.65	5.5	1.3	2.66	
PESTICIDES													
gamma-HCH	18.0	17.4	17.8	17.5	2.3	1.2	17.6	18.1	17.9	1.2	1.5	17.9	
c/s-Chlordane	59.8	61.3	62.8	62.7	4.1	1.3	62.3	60.6	61.5	2.7	1.4	61.5	
Dieldrin	86.1	89.9	89.7	90.2	4.5	0.3	89.9	87.4	86.9	2.3	1.8	88.1	
4,4'-DDE	346	348	352	355	1.7	1.0	352	362	348	2.4	2.1	354	
2,4'-DDE	31.6	31.9	32.0	32.5	1.7	1.0	32.1	31.9	29.4	3.2	4.9	31.1	
2,4'-DDT	20.8	22.7	21.9	22.5	7.8	1.9	22.4	21.1	20.7	3.2	4.1	21.4	
PCB CONGENERS													
PCB 28	163	161	166	164	1.2	1.5	164	180	172	5.4	4.8	172	
PCB 44	51.6	55.2	58.7	57.6	1.1	3.1	57.2	60.7	55.4	12	4.7	57.8	
PCB 101	304	295	297	293	3.1	0.7	295	307	305	1.4	2.1	302	
PCB 153	647	619	620	628	3.8	0.8	622	641	647	1.6	2.0	637	
PCB 105	95.1	92.0	90.7	91.4	4.0	0.7	91.4	97.8	96.4	2.7	3.6	95.2	
PCB 195	18.0	17.2	17.7	17.7	2.7	1.6	17.5	18.1	17.7	1.6	1.6	17.8	

Table VI.2. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results ($\mu\text{g}/\text{ampoule}$ unless noted) (cont.)**BATTELLE**

Compound	NIST Assigned	Within Sample - S1			Between Samples - S1, S2, S3		
		S1-A	S1-B	S1-C	S1	S2	S3
		Mean	%Error	Mean	%RSD	%RSD	%RSD
PAHs							
Biphenyl	2.81	2.91	2.90	2.91	0.2	2.91	3.08
Fluorene	3.39	3.29	3.35	3.33	0.9	3.32	3.36
Chrysene	8.11	6.58	6.80	6.84	17	2.1	6.74
Benzo[<i>e</i>]pyrene	4.84	9.91	10.3	9.74	106	2.9	9.98
Benzo[<i>a</i>]pyrene	3.72	2.54	2.60	2.41	32	3.9	2.52
Benzol[<i>ghi</i>]perylene	2.52	2.29	2.29	2.13	11	4.1	2.24
PESTICIDES							
gamma-HCH	18.0	20.1	20.5	21.2	15	2.7	20.6
cis-Chlordane	59.8	46.9	49.9	48.5	19	3.1	48.4
Dieldrin	86.1	67.0	70.1	69.5	20	2.4	68.9
4,4'-DDE	346	326	327	333	4.9	1.2	329
2,4'-DDE	31.6	21.4	23.3	23.3	28	4.8	22.7
2,4'-DDT	20.8	17.2	19.5	16.6	14	8.6	17.8
PCB CONGENERS							
PCB 28	163	110	116	31	3.1	112	127
PCB 44	51.6	37.8	42.4	36.1	25	8.4	38.8
PCB 101	304	349	354	350	15	0.8	351
PCB 153	647	711	726	731	12	1.4	723
PCB 105	95.1	71.3	82.0	73.4	21	7.5	75.6
PCB 195	18.0	8.78	10.3	10.5	45	9.5	9.86

Table VI.2. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results ($\mu\text{g}/\text{ampoule}$ unless noted) (cont.)

NAF	Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
			S1-A		S1-B	S1-C	Mean	%Error	S1	S1	S2	S3	Mean	%Error
									Mean	%RSD	Mean	%RSD	Mean	%RSD
PAHs														
Biphenyl	2.81	3.57	3.48	3.47	25	1.6	3.51	3.28	3.26	19	4.1	3.35		
Fluorene	3.39	4.00	3.87	3.88	15	1.8	3.92	3.80	3.76	13	2.1	3.83		
Chrysene	8.11	7.51	7.42	7.37	8.3	1.0	7.43	6.94	6.58	14	6.1	6.98		
Benzo[<i>e</i>]pyrene	4.84	5.14	5.04	5.02	4.7	1.3	5.07	4.75	4.58	4.0	5.1	4.80		
Benzo[<i>a</i>]pyrene	3.72	3.78	3.76	3.74	1.2	0.5	3.76	3.58	3.44	4.1	4.5	3.59		
Benzo[<i>ghi</i>]perylene	2.52	2.63	2.66	2.66	5.1	0.7	2.65	2.59	2.46	3.4	3.8	2.57		
PESTICIDES														
gamma-HCH	18.0	18.4	18.5	18.6	2.8	0.5	18.5	18.9	19.7	5.8	3.2	19.0		
c/s-Chlordane	59.8	69.7	69.0	68.7	16	0.7	69.1	67.8	70.6	16	2.0	69.2		
Dieldrin	86.1	106	105	105	22	0.5	105	104	110	24	3.0	106		
4,4'-DDE	346	397	393	391	14	0.8	394	384	405	14	2.7	394		
2,4'-DDE	31.6	37.5	37.2	37.3	18	0.4	37.3	37.1	38.2	19	1.5	37.5		
2,4'-DDT	20.8	20.3	20.3	20.2	2.3	0.3	20.3	20.4	22.6	4.3	6.2	21.1		
PCB CONGENERS														
PCB 28	163	177	177	177	8.6	0.0	177	175	182	9.2	2.0	178		
PCB 44	51.6	54.9	54.4	54.2	5.7	0.7	54.5	53.4	55.9	5.9	2.3	54.6		
PCB 101	304	234	232	231	24	0.7	232	226	234	24	1.8	231		
PCB 153	647	467	464	460	28	0.8	464	451	469	29	2.0	461		
PCB 105	95.1	87.1	85.9	85.7	9.4	0.9	86.2	83.0	88.8	9.6	3.4	86.0		
PCB 195	18.0	18.6	16.9	17.0	5.0	5.5	17.5	17.7	17.5	2.5	0.7	17.6		

Table VI.2. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results ($\mu\text{g}/\text{ampoule}$ unless noted) (cont.)

Compound	NIST Assigned	Within Sample - S1						Between Samples - S1, S2, S3					
		S1-A		S1-B		S1-C		S1	S1	S2	S3	S1-3	S1-3
		Mean	%Error	Mean	%Error	Mean	%RSD	Mean	%Error	Mean	%RSD	Mean	%RSD
PAHs													
Biphenyl	2.81	2.43		14		2.43		2.99	2.81	6.7	10	2.74	
Fluorene	3.39	2.92		14		2.92		3.59	3.31	7.4	10	3.27	
Chrysene	8.11	8.15		0.5		8.15		8.62	8.12	2.3	3.4	8.30	
Benzo[e]pyrene	4.84	4.95		2.2		4.95		5.21	5.05	4.7	2.6	5.07	
Benzo[a]pyrene	3.72	2.93		21		2.93		3.21	2.81	20	6.9	2.98	
Benzo[gh]perylene	2.52	2.39		5.2		2.39		2.60	2.50	3.1	4.2	2.50	
PESTICIDES													
gamma-HCH	18.0	15.0		20.2		17.3		11	15	17.5	22.2	17.7	9.2
cis-Chlordane	59.8	49.2		57.3		52.2		12	7.7	52.9	59.6	53.4	7.6
Dieldrin	86.1	84.8		101		94.8		9.5	8.6	93.4	106	95.4	14
4,4'-DDE	346	276		321		299		14	7.5	299	328	306	10
2,4'-DDE	31.6	25.9		30.8		27.3		11	9.0	28.0	33.5	30.7	4.8
2,4'-DDT	20.8	15.0		16.6		16.0		24	5.1	15.9	17.2	15.6	8.9
										22	22	5.3	30.7
PCB CONGENERS													
PCB 28	163	137		151		144		12	4.7	144	157	144	8.8
PCB 44	51.6	47.4		50.9		48.8		4.9	3.6	49.0	55.5	55.3	5.1
PCB 101	304	250		265		261		15	3.1	259	276	253	6.9
PCB 153	647	577		634		611		6.1	4.7	607	637	600	4.5
PCB 105	95.1	94.9		103		98.9		4.2	4.1	99.0	103	95.6	3.1
PCB 195	18.0	17.7		21.6		19.3		9.6	10	19.5	21.3	19.5	5.1
										12	12	5.1	20.1

Table VI.2. 1990 Enriched bivalve tissue extract (QA90E1) intercomparison exercise results(µg/ampoule unless noted) (cont.)

Within Sample S1:Three gas chromatographic (GC) replicates of sample 1 (S1).
Mean Absolute %Error:Accuracy indicator. The mean of the absolute percent errors of the three sample 1 replicates, S1-A, S1-B and S1-C, relative to the NIST value.
S1 %RSD:Precision indicator. The percent relative standard deviation of the S1 replicates, S1-A, S1-B, and S1-C.
S1 Mean:The mean value of the reported S1 replicates, S1-A, S1-B and S1-C.

Between Samples S1, S2, S3: Three independent sample preparations.
Mean Absolute %Error:The mean of the absolute percent errors of the S1 mean and the reported samples, S2 and S3 relative to the NIST value.
S1-3 %RSD:The percent relative standard deviation of the S1 mean and the reported samples, S2 and S3.
S1-3 Mean:The mean concentration of the laboratory's reported concentrations for the three samples, S1, S2 and S3, in which the mean value of the three GC replicates was used for the S1 concentration.

Table VI.3. 1990 ICES/IOC/OSPARCOM Second chlorobiphenyl exercise means of three injections ($\mu\text{g}/\mu\text{L}$) (from De Boer *et al.*, 1991).

Standard solution of chlorobiphenyl in isoctane	ICES	NIST	Laboratories		
			BATTELLE	NAF	TAMU
Gravimetric value					
PCB 28	40.5	43.0	38.9	47.5	46.4
PCB 31	40.0	44.6	40.7	47.9	48.8
PCB 52	43.5	42.6	52.6	38.9	52.5
PCB 101	56.0	53.5	53.9	46.1	58.2
PCB 105	41.7	42.3	39.6	73.7	44.2
PCB 118	56.0	58.3	60.9	66.4	61.3
PCB 138	82.0	68.7	86.3	99.2	91.3
PCB 153	80.0	77.3	84.3	76.3	82.3
PCB 156	41.3	36.3	38.2	60.1	41.4
PCB 180	40.0	38.4	43.5	54.8	44.2
Seal blubber extract					
Mean of selected laboratories					
PCB 28		16.9		2.1	2.6
PCB 31		5.7		0.7	0.7
PCB 52	26.2	22.2		19.6	22.5
PCB 101	70.2	88.4		51.0	60.9
PCB 105	17.8	12.9		30.1	15.9
PCB 118	43.8	44.2		40.7	39.5
PCB 138	176.	144.3		181.3	211.2
PCB 153	247	265.3		196.8	246.4
PCB 156	7.7	5.4		6.2	7.9
PCB 180	46.6	46.8		50.3	48.9

Table VI.3. 1990 ICES/IOC/OSPARCOM Second chlorobiphenyl exercise means of three injections ($\mu\text{g}/\mu\text{L}$) (from De Boer *et al.*, 1991)
(cont.).

Sediment extract	ICES	NIST	Laboratories		
			BATTELLE	NAF	TAMU
Mean of selected laboratories without outliers					
PCB 28			1.34	1.02	1.04
PCB 31			0.86	1.18	0.90
PCB 52	0.78	0.60	0.73	0.47	
PCB 101	1.43	1.07	1.39	0.97	
PCB 105		1.28	0.56	0.47	
PCB 118	1.63	1.38	1.77	1.41	
PCB 138	2.34	2.17	2.33	2.44	
PCB 153	2.43	2.22	2.65	2.95	
PCB 156		0.15	0.19	0.20	
PCB 180	1.11	1.00	1.08	0.98	

SD - Standard deviation.

%RSD: Precision indicator. The percent relative standard deviation.

n - Number of laboratories.